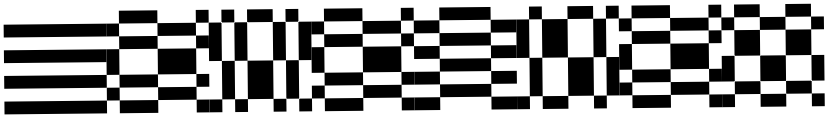
Rosa Menkman
Beyond
Resolution

Refuse to let the syntaxes of (a) history direct our futures



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BEYOND RESOLUTION

Introduction

Whiteout

Behind White Shadows

Night of the Unexpected

Refuse to Let the Syntaxes of (a) History Direct Our Futures

institutions of Resolution Disputes [i.R.D.]

Conclusion

I.R.D.
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O ≠ 1984
BEHIND
WHITE
I.R.D.
SHADOWS
one degree south of the South Pole
I.R.D. POLAR
“the pandemic of mental anguish that afflicts our time cannot be properly understood, or healed, if viewed as a private problem suffered by damaged individuals.”
- Mark Fisher.

Introduction

I opened the *institutions of Resolution Disputes* [i.R.D.] in March 2015, hosted by Transfer Gallery in New York. In September 2017, its follow-up *Behind White Shadows* opened, also at Transfer. Finally, in 2020 *Shadow Knowledge* found its way to SJSU Galleries in San José. At the heart of all three solo shows is my research into resolutions and together these exhibitions form a triptych framework for this publication: *Beyond Resolution*.

This little book also represents a journey spanning over 5 years, starting on a not so fine Saturday morning in early January 2015, when I signed the contract for a research fellowship in Amsterdam, to write a book about Resolution Studies. For this opportunity I immediately moved back from London. But unfortunately, and out of the blue, three days before my contract was due to start, my job was put on indefinite hold. During this time in limbo I developed the i.R.D, as a critique on institutions. But after the i.R.D. were finally opened and nothing in my private life was resolved, I fell into a financial and ultimately a mental black hole ⬬. Finally in 2016, when Goldsmiths decided to kill off the department of Cultural Studies, the department where I was undertaking my PhD, I gave up and resigned of all.

After some months, I finally reorganized some of my finances and relocated temporarily to the Mojave desert, where I took some time for myself, considering my next steps. There, from the porch of a little cabin looking out over a dust road, I could feel the infrasound produced by bombs dropped on Little Baghdad, a Twentynine Palms military training ground, just miles away on the slope of a hill. I became fascinated with this obscure military location where things happened beyond my understanding, yet in my direct field of perception. The situation made me revisit Trevor Paglen's book: *I Could Tell You But Then You Would Have to Be Destroyed by Me.*[1] Paglen's main field of research is mass surveillance and data collection. His work often deals with photography as a mode of non-resolved vision and a system for the production of invisible images. I felt as if I was in the proximity of such a military dark-ops space, where different forms of opaqueness were present day and night, and it got to me.

During my stay in the Mojave Desert, I undertook my first pilgrimage to the 1951 USAF resolution test target located west of Cuddeback Lake, where documentary film maker and writer Hito Steyerl's video essay *How Not to be Seen. A Fucking Didactic Educational .MOV File* (2013) is set. In this iconic video essay, Steyerl presents the viewers with an educational manual that critically considers how resolution is embedded in both digital and analogue surveillance technologies. She argues that whatever is not captured by resolution is

[1] Paglen, Trevor. *I Could Tell You But Then You Would Have to be Destroyed by Me: Emblems from the Pentagon's Black World.* NY: Melville Publishing House, 2007.

invisible and thus carries political importance. During this visit I felt finally excited again to re-start my research into resolutions, but from this time onward, independently.[2]

Soon after returning to Europe, I was incredibly lucky to receive a 5 month residency at Schloss Solitude (2017), which offered me a Schloss (a palace) to come 'home' to, and the time to develop a colloquium around Resolution Studies as an artistic practice. My research was further fine-tuned during a Vertretungs professorship in Kassel (2018 - 2020) where I shared, reworked and extended Resolution Studies with my students — an opportunity for which I am very grateful.

Resolution Studies attempts to uncover how resolutions inform both machine vision and human perception. I believe it is incredibly important to unpack the ways in which resolutions organize our contemporary (technological) processes. Considering that resolutions do not only impose how or what gets run or seen, but also what images, settings, ways of rendering and points of view are forgotten, obfuscated, or simply dismissed or unsupported. In short: resolutions are not just a determination of how something or someone is run, read and seen, but also of who or what options are compromised and *unresolved*.

Although not written as such, this booklet on Resolution Studies, *Beyond Resolution*, can be seen as a sequel to the Glitch Moment/um (Menkman, 2011). In a way, Resolution Studies encompasses glitch and glitch art, offering a more zoomed out perspective. The works I present in this publication are produced exemplary of the artifacts that appear when experimenting with the affordances of certain resolutions. Rather than a breaking a flow of operation (as the genre of glitch art is known to do), these works also question the 'normal', standard modes of operation and offer alternatives. This is why *if* positioned within the realm of glitch art, then definitely these works are a form of 'tactical glitch'.

What finally sits in front of you, *Beyond Resolution*, is an independently developed and published work - a collection of different types of texts ranging from short stories to basic optics and a manifesto like text, accompanied by a collection of artworks that I developed during the time of writing, presented in an a-chronological order. The organisation of this publication could be considered modular; the chapters can be read independently. However I did choose to order them the way they are for a reason: to present a consistently additive flow.

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[2] In the 1950s and 1960s, the United States Air Force installed various versions of these test charts to calibrate aerial photography and video. For more information on resolution test charts see research by The Center for Land Use Interpretation, "Terrestrial Test Patterns Used for Aerial Imaging."
Available here: http://www.clui.org/newsletter/winter-2013/photo-calibration-targets (20.02.20)

Beyond Resolution starts at *Whiteout*, a short story about loss induced by over-saturation. Whiteout is an account of a visceral experience: it describes the journey of climbing a mountain in a snowstorm; of being engulfed by input, yet not being able to render anything.

Whiteout is followed by *Behind White Shadows,* a chapter written after the recurring loss of authorship over my own face. During my research into this type of loss, I found it striking to learn that certain faces have become so ubiquitous, they are no longer considered to be a representation of *someone*; instead they have turned into "just pixels". In the age of hyper visibility, the face is still an often overlooked battleground. Contiguous to this, within the field of image processing, the image of the Caucasian female face has systematically been used (or stolen) for the production of color test cards, resulting into biased industry norms for color calibration and ultimately racist technologies — a fact that became a turning point into my own understanding and usage of my face within resolution studies.

The Night of the Unexpected, the following third chapter of this compendium, offers an older account of an evening in Russia, which initiated my first thinking through the material politics of screens and digital material in general and led to a need for a more substantial definition of the term 'resolution' — a redefinition that I developed in the consecutive chapter: *Refuse to Let the Syntaxes of (a) History Direct Our Futures.*

Finally, the fifth chapter of *Beyond Resolution*, *institutions of Resolution Disputes [i.R.D.]*, offers several statements on resolution studies in a manifesto-like style.

In conclusion, I would like to state, that after releasing *Beyond Resolution,* the i.R.D. (institutions of Resolution Disputes) will remain an active research platform, which, as of now, has followed a pentagon of institutions, covering the effects of scaling and the habitual, material, genealogical, and institutional use (and abuse) of the settings, protocols, and affordances shaping our resolutions, free, open and updated at www.beyondresolution.info

one degree south of the South Pole
I.R.D. POLAR

Whiteout

Point No Point Light

11 February | temp: -5c to -11c | Snow: at least 10-30 cm, often more.
It is grey. Snow in the form of fine dust is coming down. The trees bow slightly under its weight and occasionally shed a cache, which then falls down onto the forest floor, landing with a dampened “phlouf.” This is not the ideal weather to hike up a mountain, but we are doing just that.

Soon most of the trees give way, the path is now completely covered in a thick and fresh pack of snow — footsteps and the occasional boulder mark its surface. We use GPS for navigation and also carry a small hand-held device called Limenia, that picks up particular bands of the electromagnetic frequency spectrum, which it translates into humanly audible sounds.[3] Limenia serves as an interface: it distills the intangible and typically imperceptible infrastructures that are beamed around us — and even straight through us — all the time.[4]

We are on a mission to document the top of this mountain, The Brocken,[5] which like any other mountain these days is marked by humans. All over the world we have elongated nature's highest terrains with antennas, without respect for the natural stratifications they are built upon, or consideration of the panoramas interrupted. These antennas usually function as repeaters: they receive, retransmit and propagate invisible electromagnetic waves of information through the ether, as well as the natural environment. Notably, the antenna on top of this particular mountain is a remnant of the Cold War. As such, it is not only anchored in our current telecommunication networks, but in a previous — and quite possibly ongoing — position as an ear that listens in on confidential networks of telecommunication.

While we move along the trail, the atmosphere becomes denser and the wind picks up. As spatial orientation withers and our perception of the distance is curtailed to 50 meters, a visual gradient fills my viewing plane, oscillating between grey whites and white greys. This place is known for the Brocken spectre, which sometimes, when conditions are just right, appears to its visitors: an optical phenomenon in which a

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[3] A previous version of this text was first written for AX15, a project about invisible infrastructures initiated by Mario de Vega, see: http://axis.mariodevega.info/ (11.12.19).

[4] Schmidt, Paul. “Perceiving the Invisible: Speculation as Interface at Sonic Acts Academy 2018,” (Re)mistify! see: https://remystifyblog.wordpress.com/ (11.12.19).

[5] Located in a region of Saxony Anhalt, the Brocken, or Blocksberg, is the highest peak of Northern Germany, though its elevation is below alpine dimensions: 1,141 meters.

Limenia is a small antenna which translates certain frequencies of the electromagnetic spectrum to the realms of audible sound. This little handheld device was conceived and build by Mario de Vega and Victor Mazón Gardoqui, see: https://web.archive.org/web/20190811005423/http://r-aw.cc/-/limen/research/ (20.02.20)

person's magnified shadow is cast upon clouds, surrounded by a haloed rainbow.[6] Like Limenia, this apparition relies on the convergence of the intangible, but unlike radio signals, the Brocken Spectre is an embodiment of natural imaging phenomena.

The weather is not right for the phenomenon and the wind in my face brings me back to our climb. A hut offers shelter for two walkers who seem to be taking a rest. We pass them without much of a greeting as it is hard to speak. A fork in the path leads us to the right. Introduced to a barrier of fog, a roaring wind in our ears and frictious bed of snow under our feet, we find ourselves reduced to an ever slower pace. Limenia has now become the only proof of life beyond this grey enclosure. It is comforting to hear its sounds in my ears as it pings invisible infrastructures: concretizing and assigning dimensions to a space my eyes cannot see.

Impossible Images

Last month I had the opportunity to speak to several particle physicists and ask them about their favorite "impossible image." One scientist expressed a wish to have antennas mounted in his eye sockets so he could see through walls, straight into the electromagnetic spectrum. This 20/20 electromagnetic vision would reveal everything from electricity to cosmic rays, and transform our grey enclosure into a universe of colors — including colors far beyond our visible color wheel. It would clearly capture the environment introduced by the antenna: the beacon on the top of this mountain that relentlessly emits signals into the invisible-to-me realms of the radio frequency spectrum.

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[6] Atmospheric Optics, "Brocken Spectre", see: https://www.atoptics.co.uk/droplets/globrock.htm (11.12.19).

As I scale the mountain, I wonder: could there be creatures out there, in the fog, that can perceive the noise of the antenna, blasting through the ether? How much of the landscape — hidden to me through these layers of snow and fog — exists to organisms or networks that have passive electronic properties, besides my Limenia? Do my human qualities simply render me incapable of understanding the violence of these intangible signals? In short, to really read this place I would need a way to capture and transcode a vertically thickened geography: a strategy of counter-mapping that adds layers, stacks and other vertical elements to my imaging of this space.

Eyal Weizman, founder and director of Forensic Architecture, once described this as a "politics of verticality." He suggests a re-visioning of existing cartographic techniques and an "Escher-like representation of space, a *territorial hologram* in which political acts of manipulation and multiplication of the territory transform a two-dimensional surface into a three-dimensional volume."[7] Weizman also advocates for the superimposition of discontinuous modes of mapping, to construct a "sceneography" rather than a map — a form of landscape that contains a mesh of significations, which can nonetheless be *read* together, instead of simply viewed as a formal unity.

I wish I could create a *territorial hologram* of this trail, by mounting different types of antennas or other sensing technologies onto my eye sockets. I wish I could conjure a thick mesh of the sceneographies I am traversing. I wish I could visually compute the world around me. For some time, thoughts and references like these float and sink in the rhythms of the beating wind.

After some hours, we pass a signpost that signals another five kilometers awaits us. As we cross a barrier of snow the fog suddenly vanishes and in its place encroaches an enveloping white noise. Like a spacecraft going into warp drive, the wind shoots the snow-noise in our faces and eyes. I think about the different forms and shapes these tiny crystals must have and how they owe their forms to their previous environments; all this only to finally end up as a drop on my cheek — another impossible image, that makes me feel small.

The path, contoured by the light, is now twisting, crossing, intersecting, connecting, bending and elongating. Yet, as my eyes stare into the greyish white, it seems as though all may be dark: white without light / white in the dark, I had never previously imagined the darkness of white.

[7] Weizman, Eyal. "Maps of Israeli Settlements." The Politics of Verticality: *Open Democracy,* 2002. see: http://www.opendemocracy.net/ecology-politicsverticality/article_631.jsp (11.12.19).

Moving on a Line

Some years ago, through a fluke of destiny, I found myself inhabiting a little cabin in the Mojave Desert. Having rented an SUV in the hopes of gaining some horsepower I found myself disappointed with what the machine offered, but at the same time nonetheless excited to traverse this vast desert expanse. I drove for days— with gallons of water and spare batteries for my mobile device — without a route, aimlessly following the heat aberrations and dust devils into the unforeseen.

On one such drive I took a route marked with a thick line on Google Maps yet found myself on a dusty stretch of road that became narrower and narrower as I progressed — suddenly I was left without space to turn around. I was trapped on a path that slowly changed from dust to stones and then to rocks: big rocks, sometimes larger than my suspension should bear. I spent hours on that path, scared to puncture a tire. The more I progressed, the more I feared breaking down in a location more desolate than those passed in the preceding hours.

Singing to myself while probably driving slower than I would move by foot, I finally reached the end of that rocky road. I still remember the extreme relief of entering a clean stretch of asphalt, looking over a barren valley marked by the sediments of a dried lake. The valley was carved in two by the straight line of interstate 15, which stretched into the horizon. Peering into the expanse before me, I saw something surprising: a pillar of light peeking over the rim of a mountain, a strange daylight lantern, shining with an intensity that puzzled me.

Forty-five minutes later, I had crossed the distance that separated me from the daylight lantern. As I pulled up on the private road of a centralized solar farm, I swung my door open and hurried toward the edge of the field to experience its energy, half expecting to be told to move on by some security guard. Yet, it remained quiet. Endlessly quiet. There, in front of the whitest light I had ever seen, I was alone — there was nothing else: no wind, no cars, not even a hum to signal the concentration of energy right in front of me. It was just me and the whitest light in the middle of the High Mojave Desert. I had never seen such white. I closed my eyes and suddenly I lost my references to the light. It might as well have been vantablack.

Menkman, Rosa. *Whiteout* (2020) Two Channel Video, 15 minutes

Making Space and Place

I pull myself back onto the mountain where it is cold and definitely not that type of white. The weather escalated from a gentle snowfall into a storm. Vague reflections of trees and objects lost in swirling grey tones pixelate my sense of the horizon: a line that otherwise could have been a guiding beacon. Wassily Kandinsky once wrote: "A particular capacity of [the] line [is] its capacity to create surface."[8] The trail presents a space devoid of any lines and what remains is a place of distortion: lacking surface, resolution, progress, depth or end. In the *Dictionary of the English Language* (1755), Samuel Johnson observed seventeen definitions of the line. He differentiated between its function as a longitudinal extension, a string, a contour, a letter and a family line. The line is not a singular thing...

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8 Kandinsky, Wassily. *Point and Line to Plane.* US: Dover Publications, 1982: p. 576.

Maybe I could seek lines – I could try to find a line to lead me back: a border, a boundary, a frontier, an outline, a separator, a perspective, a line of flight, a guideline, a progress bar, a ruler, a red thread, a storyline, a chronology, a timeline, a vector, a ray of light, a beam, a sequence, an axis, a connector… I have none of these. Lines can offer myriad shapes and directions: horizontal, vertical, diagonal, rastrum, grid or wave; a maze, a mesh, a labyrinth. The snow usurps not only one but all possible lines. In front of me could be anything, but all remains resolutely unresolved.

Like any map, every map of this mountain is made out of lines. A thick black line describes the Railway, which swirls around the mountain's summit like the cochlea of the inner ear; while the hikers' trail approaches its top like the Eustachian tube.[9] More advanced maps feature contour lines indexing the heights of the mountain's surfaces; historical maps document the lines drawn during the Cold War, when it was partitioned by a vertical border wall and its summit was an exclusion zone (*Sperrzone*), dedicated to espionage by the East. During this time, the Brocken was no more than an imagined space to civilians. Today, the region is open and its lines and borders construct a visual record: one of experience and history inscribed in layers of linear (re)imaginings that signify mapping rather than simply a map.

Weizman states that maps exist to make it easier to navigate the world. They inform with insights and overview, yet, generally, they bear no witness to their creator(s). Rather, the map appears as a pre-composed artifact: an object derived from a space rather than a reading that is imposed on a space, which transforms it into a *place* — much like photographic inscriptions of experience that transform space to place. But, like photographs, maps are highly political objects. They define space and impose particular readings. "Two-dimensional maps, fundamental to the understanding of political borders, have been drawn again and again. But these maps are two-dimensional. Attempting to represent reality on two-dimensional surfaces, they not only mirror but also shape the thing they represent. As much as describing the world, they create it."[10] In the domains of both politics and law the concept of space is understood only in terms of the map (or sometimes, the plan) and territorial claims marked on two dimensional maps assume that claims are applicable simultaneously above them as well as below — underneath — the space that is mapped. This type of one-dimensional scaling is violent and undermines the meshes that transform space into a specific place. The spaces represented on maps are those without inhabitants: no one is present, nothing moves or makes a sound. In the map of the Brocken, we are merely blue dots scaling a two-dimensional Eustachian tube; presented with minimal

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9 The Eustachian tube is part of the middle ear. Also known as the auditory tube, it connects the nasopharynx to the middle ear.

10 Weizman, Eyal. "Maps of Israeli Settlements." The Politics of Verticality: *Open Democracy,* 2002. see: http://www.opendemocracy.net/ecology-politicsverticality/article_631.jsp (11.12.19).

references for the complexities folded into the landscape, or the histories and folklore we cross.

Over-Saturated Opaqueness

At CERN (*Conseil Européen pour la Recherche Nucléaire* [European Organization for Nuclear Research]), I spoke to a scientist who told me that humans can only remember one direction of time: the direction that accounts for the past. He speculated about the possibility of four-dimensional matter, which could help us to remember the future. Having access to such matter, we could carve slices of time — including the future — which would then help us navigate the present. A more inclusive description of the Brocken might mean the formation of a multi-dimensional volume, layered with folkloric, historical and political strata. The Brocken as a mesh that exceeds the conventional outlines drawn on the “normal” map. To conjure such a form would imply

collecting all the lines of history, ecology, thought and beyond.

But on the mountain, there are just endless snowflakes, in which I can see stories and adventures from my future and my past… But it feels like I can carve nothing. The twirls around me are not uniformly defined. The thoughts in my head are spinning as if they are dancing to the movements of the flakes. The white noise is no longer coming down from the sky but instead from all directions — up, down, left and right — without a focus, a line or a path. They have become the length and depth of my hike. All I see is grey.

In this intense flattening of perspective, we have become the distance. We are forms, lines, energies; one upon another, the matter of an intangible — though far from immaterial — situation. Walking here together, the trail has taken us deeper inside ourselves.[11] The mountain has entered us. Like Walter Benjamin once wrote, "I have become my snow globe."[12] I wonder, is the sun still there, is it fighting to reach me, above my head?

A terrible feeling of dread and loneliness comes over me. I remember this grey feeling. It is being together with people, yet still being alone. Completely and utterly alone, lost in ubiquity, like there is an invisible wall that won't let me join the state of "togetherness." Sometimes a space does not allow you to make place, to plot and situate yourself in connection to space. Sometimes a space is made of invisible rules and viscosities that keep you from inhabiting it. Although, these material properties of space may just be qualities I am not trained in. I have to learn to understand space through properties beyond my senses, my literacy and my habits. Blurred is this blizzard: a blizzard of snow and a blizzard of thoughts. Timothy Ingold wrote that "drawn threads invariably leave trailing ends that will, in their turn, be drawn into other knots with other threads."[13] Yet, things seem to be simply unravelling. I do not see the knots or threads. I feel less and less human. I am just a cold body stuck inside a sack of clothes that is trying to carry itself up a mountain.

We have walked for a long time. I am exhausted. The twirls of white noise make space for a flurry of references and images that take up the space beyond my retina. Shadows and shapes appear in the corner of my eyes, apparitions that disappear when I try to see them. The ghosts are dancing in a fog of flakes as my hair is dancing with them, reaching out like tentacles in front of my eyes. I take Limenia out again: the little instrument gives me static and a hint of something else. For a moment it sounds like music. Maybe I mishear a deep EVP (electronic voice phenomenon), or the ghosts of the weather have now started to speak through the device.

Then, suddenly there is a little clearing in the sky and I can see a shimmer of light. It is like the sun *wants* to tell me it is still there. I don´t know how long or how far we still have to go, but the Sun has given me back a sense of perspective: a vertical perspective. I have been pulled out of my grey state of being, on a mission to make it to the top of this track. On the side of the road I see spectacular installations: collaborations

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11 Leslie, Esther. *Walter Benjamin.* UK: Reaktion Books, Critical lives series, 2007: p. 78.

12 Benjamin, Walter. *Gesammelte Schriften*, vol. VII, pt.1. Frankfurt: Suhrkamp, 1991.

13 Ingold, Timothy. *Lines: A Brief History.* London: Routledge, 2007.

between the trees, the wind, snow and ice. The final stretch of the track is suddenly there, it is not too long before we reach the end of the trail and arrive at the summit of the mountain.

Cold, stiff and tired, there are only a few trees to keep us protected from the wind. The weather makes it impossible to see much, and our video and photographic equipment fails to document what remains of "the spectacle" as our lithium batteries are depleted. The full length of the Brocken's antenna is not visible, I just recognize its base, its mast shrouded in grey. There, in the snow, it is sending and repeating inaudible messages, encrypted on different frequencies, waiting for technology to pick them up for repetition or translation to another medium or node. We clearly hear its overpowering strength through the Limenia and the different rhythms at which data is sent through the ether, as well as through us, offering me just a small insight into the immensity of unresolved spectral resolutions (that I am blind to/do not perceive) with my human body.

> *It is not enough to regard the surface as a taken-for-granted backdrop for the lines that are inscribed upon it. The history of writing belongs within the history of notation, and the history of notation within the history of the line, so there can be no history of the line that is not also about the changing relations between lines and surfaces.*
>
> - Timothy Ingold[14]

Plotting Lines: Windows and Messengers

Whiteout is a story about climbing a mountain during a snowstorm — an experience that led me into a space without dimension: white in the dark and references without lines. The story of a time when I manoeuvred through slices of consciousness; traversed a virtual axis to nowhere and, finally, was pulled back into space, only for such space to collapse on me.

The Brocken Spectre never appeared to us, but for a moment, the Brocken morphed into a landscape with multiple horizons, in which the orientation discerning top from bottom did not exist except outside the mind of the wanderer. And even though events seemed to happen in the same space, this state created different places within that space, layered upon one another.

As I scaled that mountain in the snowstorm, the mountain sublimated itself into a space without lines. For a moment there were no threads, traces or cracks to fall into; lines to follow, grasp or get a hold of. The mountain showed me I need lines to understand space. In a perfect whiteout, I missed visual markers and, as a result, all lines of reference. I became my own surface. And all I had to inscribe with meaning was my own internalization of space: a quantum axis I got lost in. I then learned that a node by itself is nothing: it is just

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14 Ingold, Timothy, 'Transformations of the line: Traces, Threads and Surfaces', in: *Textile* (no.8.1, 2010): p. 12.

infinitely small. A node needs lines and connections, it needs links. And although these are ubiquitous — and therefore often ignored — they actually provide an important rationale for grounding: they organize images, vision and context.

The line is a beautiful and radical object in its capacity to represent both operation and representation. Some lines even defy classification. When dealing with materials that are non-static, opaque or invisible, we can shape their so-perceived immateriality or conjure them into materiality through approaching them as an axis. Lines can be the basis of all materiality because they invoke a surface. They form our matter. If a visitor temporarily commits to a line, they re-territorialize the environment. It is this kind of thinking about space and place that allows for seeing *through* time; through different spectra and frequencies to open different or new perspectives of visual, experiential and spatial narratives.

Maybe, to a mountain, all that matters is verticality, quantified as height above sea-level. That is why mountains are generally defined by their summits and not by greatness of rock mass or the degree of muscular exertion the hiker has to endure when scaling.[15] To me the Brocken is also a place of many imaginary lines or descriptions, that can be highlighted and then collapsed onto the mountain. Every time this occurs, the mountain is freed again and again because the act of repositioning these membranes of perspectives create a forever unfolding, non-vertical abyss of lines. Our immaterial objects are shaped by the vectors we choose, the lines we draw around them, the norms and expectations, traditions and rules; and, finally, the lines of meaning we inscribe them with. It not only matters what surface a line is drawn on, but also what lines we draw upon a surface. Finally, the scale at which we draw lines, or the spectrum through which we radiate is of note. If we can open up these levels of navigation, we can open up new "windows" (ways of seeing) to other "messengers" (beyond for instance the humanly visible part of the electromagnetic spectrum) through which we radiate. And when doing that, we may even be able to jump scales.

15 Ingold, Timothy. *The Life of Lines*. London: Routeledge, 2015: p. 32.

BEHIND
WHITE
I.R.D.
SHADOWS

BEHIND
ENEMY
LINES
I.R.D.
SHADOWS

Behind White Shadows

Blankness is as much a state of mind as it is a material condition, and as such it can be deceptive, hallucinatory, unintentional, poetic or spiritual. It can be legible or illegible, present or absent, perfect or imperfect. But it is never empty or devoid of meaning.

– Michael Gibbs[16]

White Shadows

In her 2012 lecture "White Shadows: what is missing from images" at the Gdansk Academy of Fine Arts in Poland, Hito Steyerl speaks about how new technologies force us to reformulate important questions about making visible, capturing and documenting information. In the first part of her talk, Steyerl focuses on the use of 3D scanning in forensic crime-scene investigations. Steyerl explains how the 3D scanner, or LiDAR technology (Light Detection And Ranging), sends laser beams that reflect the surfaces of the scanned objects. In this process, each point in space is measured and finally compiled into a 3D facsimile point cloud. In turn, Steyerl observes that this kind of capturing does not just provide a new image of reality but transforms our very relation to the world. Yet, Steyerl takes issue with the general belief that these emergent technologies should be accepted as the ultimate documentary and forensic devices: as tools that produces 100 percent reliable, *true,* evidence.[17]

Just like any other technology, Steyerl argues, VR has its affordances and with these affordances come blind spots. For instance, only a few scanning rigs are advanced enough to capture a moving object: they generally become a blur or are not picked up at all. A 2.5D scanning rig (a rig with just one 3D scanner) can only provide the surface data for one side of a scanned object. As a result, the final scan of an object, or space, includes blind spots: the backs of the objects and the shadows cast by objects in front of an object which, depending on the display technology, may show up as empty white shells.

To really process an environment properly, its scans would have to be taken from every angle. The barrier

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16 Gibbs, Michael. "All or Nothing and Other Pages," ed. by Gerrit Jan de Rook & Andrew Wilson. Uniformbooks, 2016: p. 10.

17 Steyerl, Hito. "White Shadows: what is missing from images," Gdansk Academy of Fine Arts, Youtube, 2012. see: https://www.youtube.com/watch?v=PoZa707a91s

"What becomes visible on the back of the image is the space that is not captured. The space that is missing, missing data, the space where an object covers the view. A shadow. […] Documentary truth and evidence also including the missing of information. The missing people themselves."
- Steyerl, Hito. "White Shadows: what is missing from images," Gdansk Academy of Fine Arts, Youtube, 2012.

presented for such a task in the case of most 3D scanning equipment is that certain elements of the scanned environment will always exist in the shadow of the next object; resulting in white patches, blank spaces, or hollowed-out shells remaining in the dataset as unseen and unregistered content.

An important question, then, not just for 3D, but for any technology is: who decides the point of view and who stands behind the perspective from which a LiDAR — or any scanning or imaging technology — is operated? In order to formulate a possible entry point for tackling this problematic, in what follows you will find a history of resolutions, specifically the history of the color test card.

The White Shadows of Image Processing:

Shirley, Lena, Jennifer and the Angel of History[18]

A fundamental part of the history of image processing and setting standardization — within both analogue and digital compression as well as codec technologies — is the test card, chart, or image. This standard test image is an image (file) used across different institutions to evaluate: image processing, compression algorithms, rendering and display quality. One type, the test pattern or resolution target, is typically used to test the rendering of a technology or to measure the resolution of an imaging system. Such a pattern often consists of reference line patterns with clear, well-defined thicknesses and spacings. By identifying the largest set of indistinguishable lines, one determines the resolving power of a given system; by using identical standard test images, different labs are able to compare results — both visually, qualitatively and quantitatively.[19]

A second type of standard test image, the color test card, was created to facilitate skin color balancing or adjustment and can be applied to test color rendering on different displays. While technologies such as photography, television, film and software all have their own color test images, these types of test images all typically involve a referencing norm that depicts a Caucasian woman wearing a colorful, high-contrast dress. Even though there were many different Shirleys (in analogue photography) or China Girls (in color film chemistry) that modeled for these test cards, they were never selected to facilitate variation. Although the identities of the many Shirleys who modeled for these norms have stayed unknown, they have nonetheless formed a collective public identity, which is often used as a standard on color test cards.[20] As such, the cards cultivated a gendered and race biased reference, which even today continues to influence our image processing technologies. In his 1997 book *White*, British film studies professor Richard Dyer observed the following: In the history of photography and film, getting the *right* image meant finding the image that conformed to prevalent ideals of humanity. This included ideals of whiteness, of what color — what range of hue — white people wanted white people to be.[21]

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18 This chapter is based on a talk I gave during Elevate Festival 2016 (Graz, Austria), for which I was kindly invited by Nora O'Murcu. I would also like to extend my gratitude to Bogomir Doringer for inviting me to present my story and research as part of his *Faceless* panel during Resonate 2017 (Belgrade, Serbia) and publish in his book of the same title. And last, but not least, to Ward Jansen who has been a driving force behind the joint acquisition of a *Vernacular of File Formats* by the Stedelijk Museum Amsterdam and Moti in 2016, which initiated my thinking on topics covered in this paper. This text also accompanied my solo show of the same name, at Transfer Gallery, New York in 2017.

19 Thorlabs, 'Resolution Test Targets'. Website. (11.12.19).
see: https://www.thorlabs.com/NewGroupPage9_PF.cfm?ObjectGroup_ID=4338

20 Gross, Benjamin. 'Living Test Patterns: The Models Who Calibrated Color TV', in: *The Atlantic* (06/28/2015).
see: https://www.theatlantic.com/technology/archive/2015/06/miss-color-tv/396266/

21 Dyer, Richard. *White: Essays on Race and Culture.* UK: Routledge, 1997.

VeriColor II testcard by Kodak.
VeriColor III, a professional portrait film developed in the early 80s by Richard Wien and his team at Kodak Park, became known for its more flexible accommodation of a range of skin colours. (Lorna Roth, *Looking at Shirley*: 2009)

The de-facto ideal standard that has been in play since the early part of the twentieth century for most analogue photo labs has thus been positively biased toward white skin tones, which naturally have a high level of reflectivity. As a result it was not only difficult to capture darker and blacker skin tones, but it also proved impossible to capture two highly contrasting skin tones within the same shot: when trying to capture a black person sitting next to a white person, the African American facial image would often lose details and pose lighting challenges. In consequence, film material generally came to depict ashen-looking facial skin colors that contrasted harshly with the whites of eyes and teeth. The Caucasian test card is thus not about variation, but about setting a *racist* standard, which has been dogmatically implemented for more than 40 years.

Analogue Photographies' Shirley Cards

The failure of photographic film stock to capture dark skin tones isn't a technical issue, but a choice. Reacting to these findings, scholar Lorna Roth writes in her 2009 article "Looking at Shirley, the Ultimate Norm" that film emulsion could have been designed with more sensitivity to the continuum of yellow, brown and reddish skin tones. The willful disregard by film companies, such as Kodacolor (1928) and Kodachrome (1935), is reasoned in terms of the markets centering of white consumers.

It was only when "chocolate" production companies and manufacturers of wooden furniture complained about the impossibilities they faced when trying to reproduce different shades of brown, that Kodak's chemists started changing the sensitivities of their film emulsions (the coating on the film base which reacts with chemicals and light to produce an image). The company gradually extended the capacities of their film stock for

greater dynamic range/ratio between the maximum and minimum measurable light intensities (white and black, respectively).[22] While progress was made over the 1970s and 1980s, it was only in 1997 that Kodak's dynamic range made a real leap forward, with the introduction of its popular consumer film Gold Max. Roth notes how Kodak executive Richard Wien described this development in terms of ability of the companies film to capture the details of a dark horse in low light.[23] Still, in the real world, true white and black do not exist — only varying degrees of light source intensity and subject reflectivity. Moreover, the concept of dynamic range is complex and depends on whether one is calculating a capturing device (such as a camera or scanner), a display device (such as a print or computer display), or the subject itself.

This is why around the same time that these changes in sensitivity of film emulsion took place, the color test card was also revisited, albeit only slightly. First, in the mid-90s, Japanese photography companies redesigned their Shirley cards using their own stock images from their own color preference tests. Since, the local reference card featured Japanese women with light yellow skin.[24] Finally, in 1995, Kodak designed a multiracial norm for their reference card.[25] From the single Caucasian woman surrounded by the necessary color balancing information codes, Kodak's Shirley has now evolved into an image of three women with different skin colors (Caucasian, Asian, African American), all dressed in brightly colored, contrasted clothing.

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22 Roth, Lorna. 'Looking at Shirley, the Ultimate Norm: Colour Balance, Image Technologies, and Cognitive Equity,' in: *Canadian Journal of Communication* (no. 34.1. 2009): p. 111.

23 Ibid.

24 Ibid.

25 Ibid.

Have your highlights lost their sparkle?
And the midtones lost their scale?
Are your shadows going smokey?
And the colors turning stale?
Have you lost a little business to labs whose pictures shine?
Because to do it right — takes a lot of time.
Well, here's a brand new system. It's simple as can be!
Its name is LAD – an acronym for Laboratory Aim Density.

– John P. Pytlak[26]

Motion Picture Color Correction: China Girls vs. Maureen the LAD girl

In a similar vain to analogue photography, from the 1920s to the early 1990s, the analogue motion picture industry had its own color test equivalent, "color-timing." The term timing hails from the days before automated printers, when the photo chemical process used a timer to determine how long a particular film strip had to sit in the developer. During the decades of color-timing, hundreds of female faces or China Girls (which some have described as a reference to the porcelain mannequins used in early screen tests) appeared in the film leaders, typically only for one to four frames, never intended to be seen by anyone other than the projectionist.

The color-timing practice was not completely reliable as it involved a different China Girl and slightly different lighting arrangement each time. Around the 1980s it was gradually superseded by the Laboratory Aim Density (LAD) system, developed by John Pytlak. Along with color-timing, the anonymous China Girls, whose occupations ranged from studio workers to models, became artifacts of an obsolete film history. Only one LAD Girl was to become the model for the color reference card: Maureen Darby.[27] Pytlak accounts that it was primarily intended as "representative" footage and not as a standard. By filming two 400-foot rolls of 5247 film, all film supplied since the introduction of LAD is made from the same original negative, either as a duplicate negative or now as a digital intermediate.[28]

Two decades later — after spending a year and a half restoring lost color strip images — Julie Buck and

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[26] Pytlak, John. 'Leader Ladies Project', Chicago Film Society.
see: http://www.northwestchicagofilmsociety.org/projects/leaderladies/ (20.02.20)

[27] Pytlak, John. "China Girl" in: *Film Tech Forums* (22.02.2006)
see: http://www.film-tech.com/ubb/f8/t004510.html (20.02.20)

[28] Monaghan, Peter. 'China Girls, Leading Ladies, Actual Women,' Moving Image Archive, 2014.
see: http://www.movingimagearchivenews.org/china-girls-leading-ladies-actual-women/ (20.02.20)

archivist Karin Segal finally found a way to bring the China Girls, or women of color-correction, to the spotlight. Rescuing the China Girls from the margins of cinema, they intended to "recast them as movie stars in their own right."[29] In their 2005 "Girls on Film" exhibition statement, Buck and Segal write: "Even though these women were idealized, they were only seen by a handful of men. Their images exist on the fringes of film. They were abused and damaged. We wanted to give them their due."[30] Unable to find any cases of China-Girls-turned-film-actresses, Buck and Segal used their collection of images to create the short, *Girls on Film* (2008);[31] wherein these absent figures were recast as stars.

You know what a black-and-white test pattern is?
she told The New York Times in 1953.
Well, I'm it for color. I'm the final check.

– Marie McNamara[32]

One Standard Does not Fit All (or: Physics is not Just Physics)

With the onset of color television there came no significant shifts: producers hired Caucasian ladies as their test models, reinforcing longstanding gender and race biases. The only difference being that in television, the objectified test model, was known by her real name. The red haired model Marie McNamara, for instance, became known in the 1950s when she modeled to calibrate the NBC television cameras, while Carole Hersee is known as the face of the famous Test Card F (and later J, W, and X), which aired on BBC Television from 1967

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29 'Artists Reveal and Reinterpret Captivating Imagery,' in: Artdaily, 2005
see: http://artdaily.com/news/14311/Artists-Reveal-and-Reinterpret-Captivating-Imagery. (20.02.20)

30 Gewertz, Ken. 'A Bevy of Unknown Beauties,' in: Harvard News Office, 2005.
see: http://news.harvard.edu/gazette/story/2005/07/a-bevy-of-unknown-beauties/ (20.02.20)

31 Buck, Julie and Karin Segal, "Girls on Film." video, 2008.
see: https://www.youtube.com/watch?v=-nVBDX3P5TY (20.02.20)
A collection of China and Lily films can be found in this article: Tom Warner, "China Girls on Film, 2017.
see: http://acceleratteddecrepitude.blogspot.com/2017/03/china-girls-on-film.html (20.02.20)

32 McNamera, Marie, in: New York Times, 1953.
Gross, Benjamin. 'Living Test Patterns: The Models Who Calibrated Color TV', in: *The Atlantic* (06/28/2015).
see: https://www.theatlantic.com/technology/archive/2015/06/miss-color-tv/396266/

to 1998.[33]

Cameramen continued to use Caucasian color girls — either as live models or as photographs — to test their color settings. If an actor with a different skin color entered the scene, the calibration process was supplemented with special lighting or makeup techniques to ensure that the non-white participants looked good on screen — a task that is not always easy and deferred the development and implementation of adequate, non-biased technologies. Such conditions led Lorna Roth to conclude, in her seminal article, that the habitual racism embedded within color reference cards did more than just influence major standard settings: the tone of hue, chroma, contrast, quantization, and lightness (luminance) values. To her, it is also responsible for the highly deficient renderings of non-Caucasian skin tones, which have resulted in an ongoing need for compensatory practices.

This one size fits all is problematic, as a technician once explained to Roth: physics is physics approach has become the standard, in reality, the various complexions reflect light differently. What this reveals is a composite interplay between the different settings involved when capturing the subject. Despite the obvious need to factor in these different requirements for different hues and complexions, television technically only implemented support for one – the Caucasian complexion.[34]

Moreover, the history of color bias did not end when old analogue standards were superseded by digital ones because digital image (compression) technologies too, inherited these standards. As a result, even contemporary standards are often rooted within these racist, habitual practices. New digital technologies still feature embedded racial biases. For instance, in 2009 and 2010 respectively, HP webcams and the Microsoft's X-Box Kinect controller had difficulties tracking the faces of African American users. Consumer reports later attributed both problems to low-level lighting, again moving the conversation away from important questions about skin tone to the determination of a *proper* lighting level — discussions continue to echo naive physics justifications.

Lena JPEG

In his retrospective article "How I Came Up with the Discrete Cosine Transform (DCT)," Nasir Ahmed describes his conception of the use of a cosine transform in the field of image compression. Ahmed recollects

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[33] Gross, Benjamin. 'Living Test Patterns: The Models Who Calibrated Color TV,' in: *The Atlantic* (06/28/2015). see: https://www.theatlantic.com/technology/archive/2015/06/miss-color-tv/396266/

[34] Roth, Lorna. "Looking at Shirley, the ultimate norm: Colour balance, image technologies, and cognitive equity" in *Canadian Journal of Communication* (no. 34.1, 2009): p. 118.

how he proposed the National Science Foundation (NSF) study for the application of the cosine transform and how much to his disappointment, the NSF did not support the proposal, because the whole idea seemed too simple.[35] Ahmed decided to keep working on the problem, ultimately publishing his results in the January 1974 issue of *IEEE Computer Transactions*. Today, more than 40 years after Ahmed's proposal, DCT is widely used in digital image compression. For instance the algorithm has become a core component of JPEG image compression technology, which is developed by the JPEG Experts Group.[36]

> I remember dedicating the whole summer of 1973 to work on this problem. The results that we got appeared too good to be true, and I therefore decided to consult Harry Andrews later that year at a conference in New Orleans. […] When I sent the results back to Harry Andrews, he suggested that I publish them. As such, I sent them to the IEEE Computer Transactions, and the paper was then published in the January 1974 issue. […] Little did we realize at that time that the resulting ›DCT‹ would be widely used in the future![37]

Shortly after Ahmed's initial proposal, the implementation of DCT for digital image compression also became a subject of experiments at the University of Southern California's (USC) Signal and Image Processing Institute. In a 2001 newsletter, Jamie Hutchinson offers an insightful reflection on how the testing of DCT again focused on the implementation of a Caucasian female color test card. Hutchinson quotes Alexander Sawchuk, who reminisces on his efforts to implement the test card during his time as assistant professor of electrical engineering. Sawchuk explains that he and his colleagues were tired of the normal test images or "dull stuff." They wanted something glossy to ensure good output in dynamic range and they wanted a human face. Just then, somebody happened to walk in with a recent issue of Playboy.[38] Sawchuk moves on to describe how they ripped out the centerfold of the Playboy and scanned its top third with their Muirhead scanner, which they had customized with analog-to-digital converters to create a three-channel, 512 x 512px, test image. After the tricky processing stage was finished, Sawchuk realized that they had lost a line while scanning. Moreover, the timing of the analogue-to-digital converters was off, making the final test image slightly more elongated than the original. Faced with time pressure, the engineers settled for the distorted version and simply replicated the top

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35 Ahmed, Nasir: How I Came Up with the Discrete Cosine Transform. Electrical and Computer Engineering Department, University of New Mexico, Albuquerque, New Mexico in: *Digital Signal Processing 1.1* (1991): p. 4-5.

36 For an overview of the JPEG standard see: https://jpeg.org/jpeg/index.html (20.02.20)

37 Ahmed, Nasir: How I Came Up with the Discrete Cosine Transform. Electrical and Computer Engineering Department, University of New Mexico, Albuquerque, New Mexico in: *Digital Signal Processing 1.1* (1991): p. 4-5.

38 Hutchinson, Jamie. 'Culture, Communication, and an Information Age Madonna,' in *IEEE Professional Communication Society Newsletter* (v.5 no,3, 2001): p. 1–7.

line to arrive at 512. Those three sets of 512 lines — one set for each color, created imperfectly — would become the de facto industry standard.

The Miss November 1972 centerfold, that the USC employees used for testing the implementation of DCT, featured the Caucasian model Lena Sjööblom (or today Lena Forsén). Lena quickly became the single most used picture in image-processing research and notably one of the first pictures uploaded to ARPANET (the precursor of today's internet). In *A Note on Lena* (1996), David Munson, University of Illinois professor and editor-in-chief at IEEE Transactions on Image Processing, explains why he believes the Lena image became an industry standard: "First of all the image contains a nice mixture of detail, flat regions, shading, and texture that do a good job of testing various image processing algorithms. It is a good test image! Second, the Lena image is a picture of an attractive woman. It is not surprising that the (mostly male) image processing research community gravitated toward an image that they found attractive."[39] Munson goes on to describe why the Lena image has become such an issue: "Some members of our community are unhappy with the source of the Lena image. I am sympathetic to their argument, which states that we should not use material from any publication that is seen (by some) as being degrading to women."[40]

While the use of the Lena image remained a topic of discussion — not to mention the rights of use never being confirmed or even checked with Playboy — by 1991, USCs Signal and Image Processing Institute (SIPI) actually started distributing the image of Lena for a fee, to researchers all over the world. While Lena was regularly found on the pages of image processing journals, books and conference papers, Playboy finally became aware of the transgressions after the Journal of Optical Engineering featured Lena on its July cover. In August 1991, Optical Engineering received a letter from Playboy Enterprises Inc. asking them, as fellow publishers, to cease any unintentional, unauthorized use of the image and to contact Playboy for permission for any future use of their copyrighted material. The International Society for Optical Engineering (SPIE) responded, arguing that, "The image is widely used in the worldwide optics and electronics community. It is digitized and its common use permits comparison of different image processing techniques and algorithms coming out of different research laboratories."[41] They also pointed out that SPIE is a nonprofit scientific society and that the material published by SPIE is intended for educational and research purposes.

SPIE eventually reached an agreement with Playboy, disclosing a warning in their January 1992 editorial

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39 The Lena image was actually not the first Playboy image used as testcard for image calibration. The first Playboy magazine centerfold known to be utilized to illustrate image processing algorithms dates back to 1961, when Lawrence G. Roberts used two cropped 6-bit grayscale scanned images from Playboy's July 1960 issue (featuring Playmate Teddi Smith), for his MIT master's thesis on image dithering.

40 Munson, David C., 'A Note on Lena,' in: *IEEE Transactions on Image Processing* (no. v.5 no.1, 1996): p. 3.

41 Thompson, Brian J. 'Editorial,' in: *OPTICAL ENGINEERING* (V. 31 no.1): p. 5.
see: http://webcache.googleusercontent.com/search?q=cache:h_JsSzpi8coJ:www.lenna.org/optical.html+&cd=2&hl=en&ct=clnk&gl=jp&lr=lang_de%7Clang_en

that it is each author's responsibility to make sure materials in their articles are either free of copyright or that permission from the copyright holder has been obtained. Seeing an opportunity, Eileen Kent, vice president of new media for Playboy, publicly commented on the issue: "We decided we should exploit this, because it is a phenomenon."[42] SPIE was granted authorization for all further use of the image. According to publications director at SPIE Eric Pepper, it was almost as if Lena had entered the public domain by that time — almost, but not quite.[43]

In May 1997, almost 25 years after being Miss November, Lena Söderberg attended the fiftieth anniversary of the Imaging Science and Technology (IS&T) Conference in Boston. Jeff Seideman, the president of the Boston IS&T, arranged for Lena to appear and after the event Seideman started working with a Playboy archivist on rescanning Lena's image in the hopes of recovering missing information, such as: the type of photo emulsion used to make the print featured in the magazine and the technical specifications of the scanner. As a result, Seideman hoped that the image of Lena would remain a standard reference image for compression technologies throughout the twenty-first century. Even today, the standard Lena test image is downloadable from several laboratory sites.[44]

Notably, the controversy around the Lena image did not end in the 1990s. In 2001, David Munson, editor of the IEEE's image processing journal, wrote:

> It was clear that some people wanted me to ban Lena from the journal […] People didn't object to the image itself, but to the fact that it came from *Playboy,* which they feel exploits women. Rather than ban Lena, Munson wrote an editorial in which he encouraged authors to use other images.[45]

In 2016, Scott Acton, editor of IEEE Transactions, proposed the journal's editorial board instate a prohibition on the use of Lena in any published research: "We could be fine-tuning our algorithms, our approaches to this one image. […] They will do great on that one image, but will they do well on anything else? […]." In 2016, demonstrating that something works on Lena isn't really demonstrating that the technology works. Acton

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42 Brown, Janelle. 'Playmate Meets Geeks Who Made Her a Net Star' in: *Wired News*, (20.05.97).
see: https://www.cs.cmu.edu/~chuck/lennapg/wired_backups/4000.html.
see: http://www.lenna.org/wired_backups/4000.html (20.02.20)

43 Hutchinson, Jamie. 'Culture, Communication, and an Information Age Madonna,' in: *IEEE Professional Communication Society Newsletter* (v.5 no.3, 2001): p. 1–7.

44 Asuni, Nicola and Andrea Giachetti, 'TESTIMAGES: A Large Data Archive for Display and Algorithm Testing,' in: *Journal of Graphics Tools* (no.17 v.4, 2013): p. 113–125.

45 Hutchinson, Jamie. 'Culture, Communication, and an Information Age Madonna,' in: *IEEE Professional Communication Society Newsletter* (v.5 no.3, 2001): p. 1–7.

believed that the Lena image doesn't send the right message to female researchers about their inclusion in the field. But Acton's strongest objections were technical in nature: Lena contains about 250,000 pixels, some 32 times smaller than a picture snapped with an iPhone 6. And then there's a quality problem: The most commonly used version of the image is a scan of a printed page. The printing process doesn't produce a continuous image, but rather a series of dots that trick your eye into seeing continuous tones and colors. Those dots, Acton says, mean that the scanned Lena image isn't comparable to photos produced by modern digital cameras. Short of an all-out ban in the journal, he says, making authors aware of the image's technical and ethical issues might be a way to usher Lena gracefully into retirement.[46]

While it is clear that the use of the Lena image opened a discussion about embedded bias and the consideration of gender in test card usage, many questions remain unanswered. How much are the performance, texture and materiality of digital photography actually influenced by the use of the image of Caucasian Lena? What would it have meant for the standardization of digital image compression if the image chosen for the test card would have been the first African American Playboy centerfold Jennifer Jackson (March, 1965); or if the 512 x 512 pixel image had instead featured the image of Grace Murray Hopper, one of the first African American pioneers in computer programming and the person responsible for inventing some of the first compiler-related tools — moreover, the woman who, coincidentally, coined the widely used computer slang "bug." How much do the compression standards we use on a day to day basis reflect the complexities of the good 512 x 512 pixel Lena image and how well do these standard settings function when capturing another kind of color complexity?

46 Iozzio, Corinne. 'The Playboy Centerfold that Helped Create the JPEG,' in: *The Atlantic*, 2016.
see: https://www.theatlantic.com/technology/archive/2016/02/lena-image-processing-playboy/461970/ (20.02.20)

Dullaart, Constant. Jennifer in Paradise, 2013.

Dear Jennifer,

Sometime in 1987, you were sitting on a beach in Bora Bora, looking at To'opua island, enjoying a holiday with a very serious boyfriend. […] This photograph of a beautiful moment in your personal history has also become a part of my history, and that of many other people; it has even shaped our outlooks on the world at large. John's image of you became the first image to be publicly altered by the most influential image manipulation program ever. […] In essence, it was the very first photoshop meme — but now the image is nowhere to be found online.

Did John ask you if he could use the image? Did you enjoy seeing yourself on the screen as much as he did? Did you think you would be the muse that would inspire so much contemporary image making?

Did you ever print out the image? Would you be willing to share it with me, and so, the other people for whom it took on such an unexpected significance? Shouldn't the Smithsonian have the negative of that image, not to mention digital backups of its endless variations?

All these questions have made me decide to redistribute the image ›Jennifer in Paradise‹ as well as I can, somewhat as an artist, somewhat as a digital archeologist, restoring what few traces of it I could find. It was sad to realize this blurry screen grab was the closest I could get to the image, but beautiful at the same time. How often do you find an important image that is not online in several different sizes already?[47]

IIIIennifer in Paradise (Constant Dullaart, 2013)

A woman is sitting with her back toward us, topless, on a beach. Silver sand, blue water, a green island in the distance. We can't see her face but we know her name: Jennifer. This photo, taken in 1987 by one of the two creators of Photoshop, John Knoll, became the standard test image for the development and implementation of Photoshop and its suite of creative effects. Twirling, deleting and copying Jennifer were just some of the myriad processes tested on the image. At that time, the early days of digital computing, there was not a large array of digital images available, which is why this 24-bit scan of a holiday photo of John's soon-to-be Jennifer Knoll became a standard test image for all Photoshop's developments. It is also one of the reasons why the image did not disappear when Photoshop moved out of its development phase. When Photoshop was finally ready for public use, John and his brother Thomas used the image again and again in online demos. It was a good image to do demos with, John Knoll recalls, as it was pleasing to look at and there were a whole bunch of things you could do with that image technically.[48]

As Dutch artist Constant Dullaart explains in his Chaos Computer Club presentation *The Possibility of an Army*, John Knoll confirmed an age-old motif: a man objectifying a female body.[49] Besides being critical, Dullaart also underlined the special cultural-historical value of the artifact, which formed a key inspiration for his 2013 Future Gallery solo show *Jennifer in Paradise*. In this show, Dullaart focused on the excavation and

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47 Dullaart, Constant and John Knoll. 'Jennifer in Paradise – the correspondence,' in: *Carroll / Fletcher Onscreen*: 1 March 2016.
see: http://carrollfletcheronscreen.com/2016/03/01/jennifer-in-paradise-the-correspondence/.

48 Comstock, Gordon. 'Jennifer in Paradise: the story of the first Photoshopped image,' in: The Guardian, 2014.
see: https://www.theguardian.com/artanddesign/photography-blog/2014/jun/13/photoshop-first-image-jennifer-in-paradise-photography-artefact-knoll-dullaart.

49 Constant Dullaart, *The Possibility of an Army,* presentation at 32c3, 2015.
see: https://media.ccc.de/v/32c3-7517-the_possibility_of_an_army.

exhibition of a reconstruction of the Jennifer image. In an open letter accompanying the show, Dullaart describes the image of Jennifer as an important artifact in the history of software development and as an anecdote in Adobe history. He asks Jennifer to share the original image file with the world. A sentiment that was later echoed by Gordon Comstock in a 2014 piece for *The Guardian*, in which he describes the image as central to the modern visual vernacular as Eadweard Muybridge's shots of galloping horses or the first use of perspective. In a way, just like the Lena image, Jennifer has become a phenomenon.

While Dullaart never obtained any rights or permissions for the use of the Jennifer image, he did digitally reconstruct the original image, creating an image series consisting of Photshopped versions, materialized as wallpaper, and a series of prints featuring enthusiastically filtered *Jennifers* (twirled, blurred, etc.). Dullaart also spread the digitally reconstructed version of the original image with an added payload: steganographically adding messages to the reconstructed JPEG image file. In doing so, he intended to treat the JPEG image not just as an image, but as a unique container format for content. This, he hoped, would open a debate on the value of the digital file (format). The reconstructed Jennifer JPEG is not just a format that carries the reconstructed image information. Via the steganographic technique it has become a unique container and placeholder for discussing the materiality of digital photography. In terms of monetization of the material, Dullaart only sells the password to the encrypted payload added to the reconstructed version of the original JPEG — the access to his secrete message. Finally, in an effort to translate the work for the context of the gallery, Dullaart organized a performance in which he briefly showed his secret message written in phosphorescent paint on top of the wallpaper by shining a blacklight on its surface, followed by a destruction of the blacklight as a metaphor for encryption (and inaccessibility).

Dullaart never received a direct response from Jennifer or John Knoll to his request to enter the original image into the public domain or to gift it to a (media) archeological institution such as the Smithsonian. Remarkably, for his article in the Guardian, Comstack did manage to get a short response from both:

> John Knoll seems unconvinced: "I don't even understand what he's doing," he says, bristling at the idea of the image being reconstructed without permission (ironically using Photoshop). Jennifer is more sanguine: "The beauty of the internet is that people can take things, and do what they want with them, to project what they want or feel," she says.[50]

And maybe even more remarkable is the fact that the article features just one image: the original *Jennifer in Paradise* photo taken by John Knoll, embedded on the newspaper's website (and thus finally entering the digital domain). Albeit indirectly, Dullaart had now fulfilled one of the main goals of his solo show.

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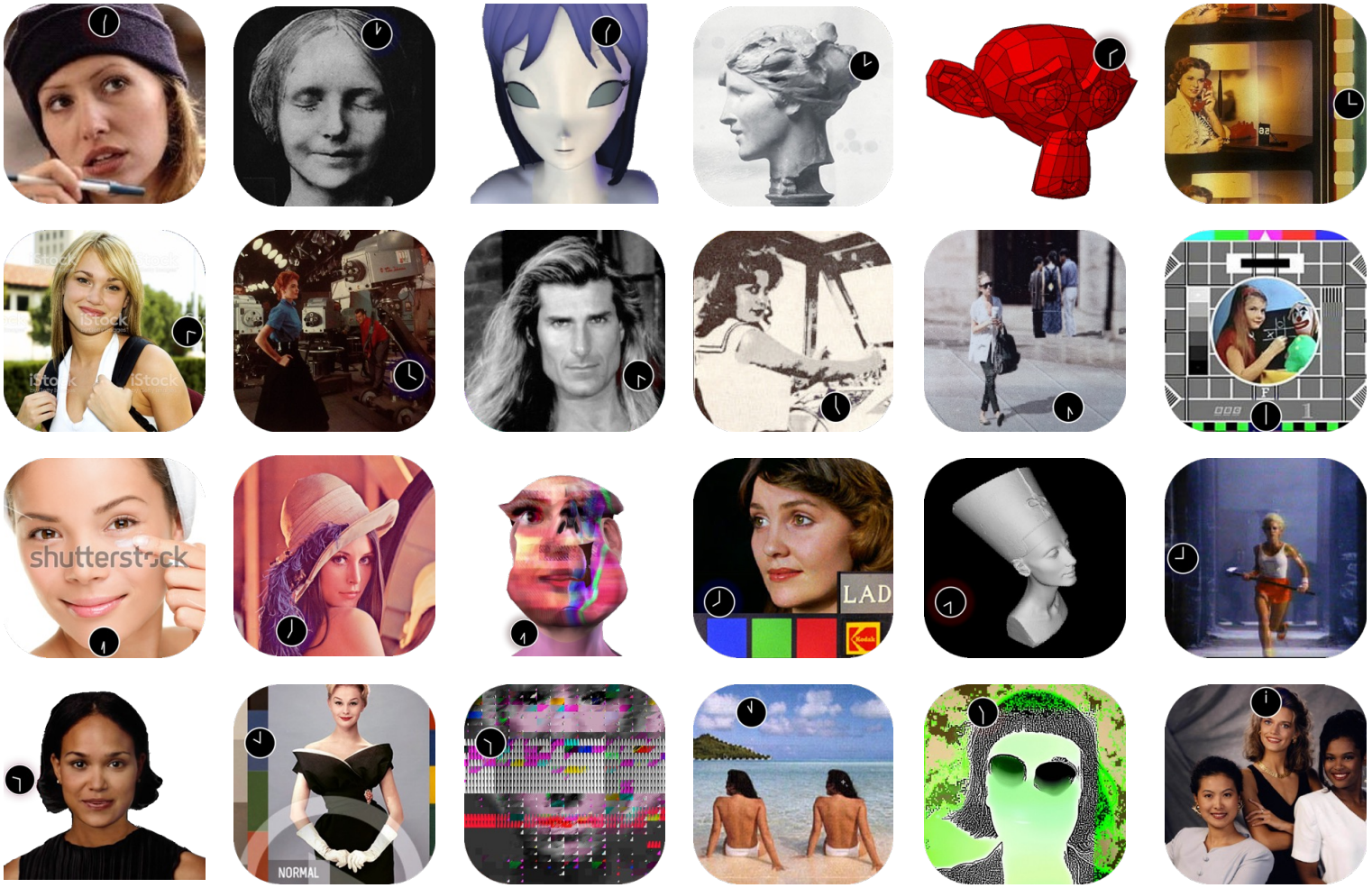
50 Comstock, Gordon. 'Jennifer in Paradise: the story of the first Photoshopped image,' in: The Guardian, 2014. *see:* https://www.theguardian.com/artanddesign/photography-blog/2014/jun/13/photoshop-first-image-jennifer-in-paradise-photography-artefact-knoll-dullaart.

Pique Nique pour les Inconnues

Desktop video installation 2019-2020.

Pique Nique pour les Inconnues considers the ways in which the history of technology has been defined by standardization, in particular through the use of color test cards for image processing. The work presents les Inconnues - unknown women whose images are linked to the history of image processing. In this work, test cards, bots, virtual assistants, stock photos and others find a voice, but fail to recover their personhood.

Engineers used these female objects to evaluate the quality of image processing, rendering and composition of architecture and to make these latent spaces more amicable. While these women seem to be able to prolong their existence for as long as the (digital) realms will copy and reuse them, most of them have lost their name and identity. In this work, the viewer is haunted by the familiarity of these digital ghosts, while at the same time, privy to an uncanny experience when the historically mute images speak for the first time.



ique Nique pour les Inconnues (2019-2020)

Telegram sticker set

A fundamental part of the history of image-processing, webdesign, and the standardization of settings within both analogue and digital media are test cards, placeholder images, bots, digital actroids or virtual assitants. Engineers use these images to evaluate the quality of image processing, the rendering and composition of the architecture of a (digital) space, but also simply to make latent spaces more amicable.
However, just like the canned laughter tracks of televisions shows, that are made by real people who were immortalized when they lend their laughs in the 30s or 40s, these women too seem to have prolonged their exitence for as long as the (digital) realms will copy and reuse them. They have become a "shell without a ghost".

1:00 l'Inconnue de la Seine (after 1900)
The Unknown Woman of the Seine is a death mask of an unidentified young woman that became a popular fixture on the walls of artists' homes after 1900. She featured in various artists works ranging from books to theatre and film. But while many artists felt inspired by her borrowed visage, little but her moniker is known about her and she remains forever an asset with missing values.

2:00 Audrey Munson Bust (1913-1915)
The bust "The Spirit of Life", by Daniel Chester French (1913-1915), inspired by 'America's First Supermodel' Audrey Munson. Munson was the inspiration for more than 12 other statures in New York City, and many, many others elsewhere. Chances are that when you cross a statue, it might be modelled after her.

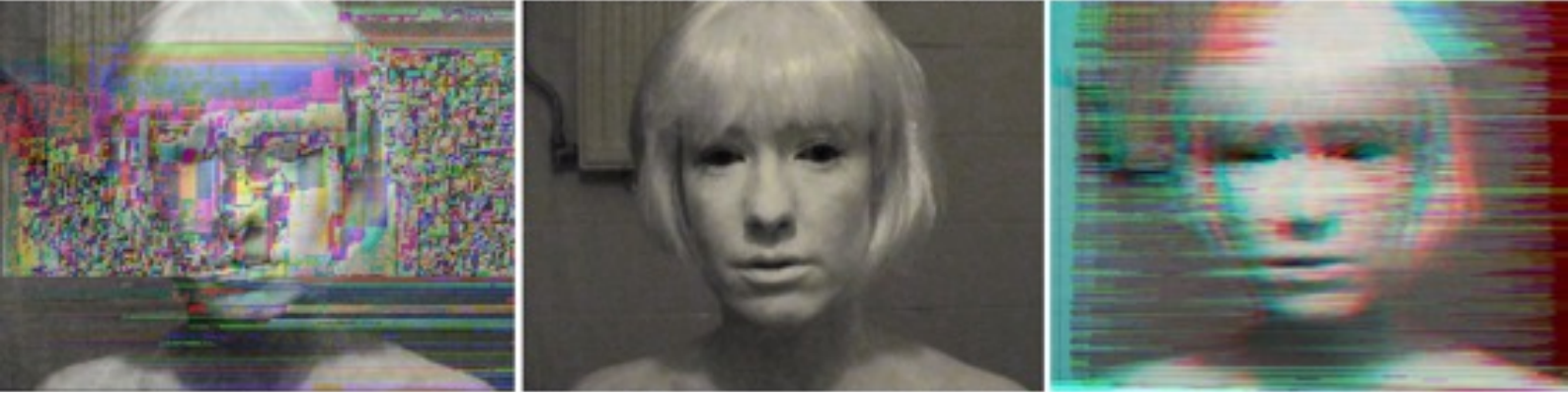
3:00 Color-timing control strips
Officially known as color-timing control strips, these anonymous female film studio workers were affectionately dubbed "china girls" by the industry, but are also known as leader ladies or lilys. The images in this show were meant only for use by the processing lab to match color tones in the associated film. They were often film lab workers themselves.

4:00 Miss NBC (1953)
The onset of color television brought no big surprise; in this medium too, producers hired Caucasian ladies as their test models, reinforcing longstanding biases in gender and race—the only difference being that in television, the objectified test model was known by her real name. The red-haired model Marie McNamara, for instance, became known in the 1950s when she modelled to calibrate the NBC television cameras, while CBS used a girl named Patty Painter.

5:00 Two Bit Teddi Smith (1961)
Lawrence G. Roberts used two different, cropped 6-bit grayscale scanned images from Playboy's July 1960 issue, featuring Playmate Teddi Smith, in his MIT master's thesis on image dithering.

6:00 Carole Hersee (1967)
Hersee is known as the face of the famous Test Card F (and latter J, W, and X), which aired on BBC Television from 1967 to 1998.

More: https://beyondresolution.info/Les-Inconnues



Menkman, Rosa. *A Vernacular of File Formats,* 2010.
see: https://beyondresolution.info/A-Vernacular-of-File-Formats (20.02.20).

In Front of the Angel of History

Covered in a heavy layer of white make-up, she shot her face on a DV tape. She wished to mask her flaws, to be perfect. But only a short time into the shoot, the illusion shattered and she found herself forced to visit the emergency room. An allergic reaction to the makeup hurt her eyes violently and left her sight affected for days.

Behind the Angel of History

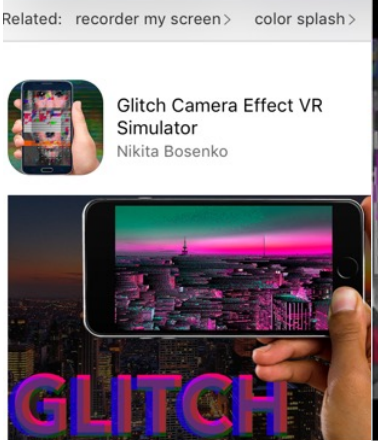
Seven years after shooting the source footage for *A Vernacular of File Formats: An Edit Guide for Compression Design* (2010), it has become strange to think and refer to the image that I shot that day as a self-portrait: that image being my image. When I shot it, it was a symbol of my own imperfect being. I tried to be perfect like porcelain, at least from the outside, but my body broke out and reminded me that there is no such thing as perfection. Not even in make believe video.

As I aged, it wasn't just the cliche of time — which healed the wounds of bloodshot eyes, and slowly but naturally grayed my hair — that changed my relation to this particular shot. As time passed, the relationship between me and that image fundamentally changed because of other more complex and unexpected reasons.

Vernacular of File Formats

A file format is an encoding system that organizes data according to a particular syntax or compression algorithm. The choice of a particular image compression algorithm is based on its foreseen mode and place of usage; therefore prompting questions such as: how much accuracy is necessary for a particular task? What hard or software will process the image? What data is important and what can be discarded?

An image file format answers to certain affordances. Affordances or — as described by James Gibson in 1977 — preferred object action possibilities, are created by considering settings such as speed, size and quantity



as relative to each other.[51] The bigger the file, the more time it will take to read and write it from memory and the slower the camera will respond. As Adrian Mackenzie wrote in 2008:

> Software such as codecs possess several analytical problems. Firstly, they are monstrously complicated. Methodologically speaking, coming to grips with them as technical processes may entail long excursions into labyrinths of mathematical formalism and machine architecture, and then finding ways of backing out of them bringing the most relevant features. […] Second, at a phenomenological level, they deeply influence the very texture, flow, and materiality of sounds and images."[52]

Reverse engineering as a standardization process is thus complex, if not generally impossible. Although standards are often set in a way that avoids or hides all traces of testing and standardization regimes, traces can (re)surface in the form of flaws, inherited dogmas, or (obsolete) artifacts. Every compression algorithm comes with its own set of rules and compromises, which, even though often invisible, influence our media on a fundamental, meaningful, and often compromising level. In *A Vernacular of File Formats*, I explore and uncover these otherwise hidden protocols and standards. Through a series of corrupted self-portraits, I illustrate the language of compression algorithms. *A Vernacular of File Formats* consists of one source image, the original portrait, and an arrangement of recompressed and disturbed iterations. By compressing the source image using different compression languages and subsequently implementing the same (or similar) error into each file, the normally invisible compression language presents itself on the surface of the image. Besides every iteration of the image I also try to give an explanation of how I disrupted the image and the basic affordances of the compression responsible for its aesthetic outcome. In doing so, *A Vernacular of File Formats* was not only a start for my ongoing research into the politics of file formats and their inherent resolutions, but is also a

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[51] Gibson, James J. *The ecological approach to visual perception: classic edition*. Psychology Press, 2014.

[52] Mackenzie, Adrian: Codecs, in: Fuller, Matthew, ed. *Software studies*: *A lexicon.* Mit Press, 2008: p. 48-54.

thesaurus, or handbook, for glitch aesthetics — the aesthetics of digitally disturbed imagery.

After releasing *A Vernacular of File Formats*, these images initially circulated quite naturally, following the random flow of the Internet. Some of them were republished with consent or attribution, others were badly copied without attribution. Once in a while, I found my face as a profile picture on someone else's social media account. It became clear that particular iterations of the self-portrait had quite a bit more traction than others; these got frequent requests and pulls and were featured on the covers of books, magazines and online music releases. One of the images became a mascot for a festival in Valencia, included in a poster campaign throughout the city.

It was only some years after the release of *A Vernacular of File Formats* that the displacement of the portrait made me rethink my relation to the image. The first time this happened was when I read a description of the work in a piece by Kevin Benisvy, at the time a student at the University of Massachusetts. Benisvy writes that the protagonist is presented in the act of brushing her hair, with an almost "come hither" expression, as if caught by surprise, having an intimate moment in a Playboy erotic fiction.[53] I never considered the image erotic, to me, the image contains painful memories — being, after all, a documentation of me losing my vision for a certain amount of time. Reading this gave me insight into the various readings the image could evoke.

Soon after, a sequence of nonconsensual, non-attributed instances of exploitation appeared: the face became an embellishment for cheap internet trinkets such as mugs and sweaters; was featured on the cover of a vinyl record by Phon.o released by the Berlin label BPitch Control; an application button for two proprietary glitch software apps for iPhone and Android; as an outline for the face of Yung Joey (a rapper who photoshopped his face onto mine), and was also used in a sponsorship campaign for a Hollywood movie about a woman being stalked; to name just a few surprising appearances.[54] The image, exploited by artists and creators alike, started to lose its connection to the source — to me — becoming the portrait of no one in particular, a specter, similar to a Shirley test image, though in this case, a Shirley for de-calibration.

During the winter of 2016 — six years after the creation of *A Vernacular of File Formats* — the *Vernacular* was invited to be part of a large-scale, joint acquisition of Stedelijk Museum Amsterdam and MOTI.[55] After thorough consideration, the institutions agreed that the best format for the purchase would be the full archive of digital files, which consists of over 16GB of data (661 files), including the original and glitched,

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53 Benisvy, Kevin. 'The Queer Identity and Glitch: Deconstructing Transparency,' 2012. http://www.kevinbenisvy.com/sites/default/files/2012%20-%20The%20Queer%20Identity%20and%20Glitch.pdf (site discontinued)

54 I have been in touch with both Phon.o and the creators of the sponsorship campaign after their respective releases, and now have my consent for using the image.

55 Press Release: AANKOOP 17 TOPWERKEN DOOR STEDELIJK EN MOTI Nieuws — 15 dec 2016. Stedelijk Museum Amsterdam. see: https://www.stedelijk.nl/nl/nieuws/aankopen-stedelijk-en-MOTI (20.02.20).

or broken image files, the PDF, videos, documentation and a collection of (unsolicited) appropriations. While the whole collection now remains in the archive of the Stedelijk, *A Vernacular of File Formats* will also remain freely available online, inviting artists and designers to use the files as source footage for their own work and research, following the spirit of COPY < IT > RIGHT !:

> First, it's okay to copy! Believe in the process of copying as much as you can; with all your heart is a good place to start – get into it as straight and honestly as possible. Copying is as good (I think better from this vector-view) as any other way of getting, "there."[56]

Specters Controlling Our Imaging Technologies

By now it should be clear that while taking an image of the face and saving it to memory seems like a simple, straightforward act, in fact a large set of protocols and standards intervene in the processes of saving the image to memory — including, but not limited to: scaling, reordering, decomposing, and reconstituting image data. All of which is directed toward certain affordances, which cater to techno-conventional, political and historically *biased* settings often geared primarily to efficiency. Some of these biases can be traced back to the history of the color test card; a history which can offer an insightful perspective on how image compression standards have come to exist.

The first color test cards were developed almost a century ago. They would feature a Caucasian, anonymous, brightly-dressed girl, smiling in a friendly way at the camera. Throughout the many legacies and histories of image processing — including, but not limited to analogue photography, film, television, the JPEG algorithm and even Photoshop effects — this trope grew into a habitual racial bias, violently lodged under the fold of efficient image processing. The habitual use of Caucasian test cards — such as the Lena photo — led to the development of certain affordances in the compression algorithm scaling; sometimes even cutting away image data. It is important to be aware that a bias does not *just* influence the final rendering of the image; the bias also exists in what a technology does *not* show: what it obscures or obfuscates and what image data simply deletes. The Shirleys, but more importantly the technicians that implemented the use of these Shirleys or color reference cards, cast white shadows: patches of unregistered information during image processing. And while artists such as Hito Steyerl or Constant Dullaart make an effort to spread awareness around the biases and habits that are embedded in the histories of resolutions, even today, a history of these specters influences our images — albeit often invisibly from the perspective of the unaware observer.

Six years after releasing *A Vernacular of File Formats*, and after close study of some of the histories of

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56 Morton, Phil. 'Distribution Religion,' 1973, republished in: *Re:Copying-IT-RIGHT-AGAIN. Relive: Media Art Histories,* ed. Jon Cates. MIT Press, 2013: p. 337.
see: http://criticalartware.net/DistributionReligion/DistributionReligion.pdf

Menkman, Rosa: A Color Test Card for Image De-calibration, BLINX 1.
From: A Vernacular of File Formats, 2011. published in Vogue 2018.

standardization and resolution setting, I realize that by using my own face as a Shirley card for *de*-calibration, I unintentionally aligned myself with the historical trope of the Caucasian test card. Just as Jeff Seidemann once said about Lena: *when you use a picture often, it becomes merely pixels* [57]— my face had become *just pixels,* or even, I had simply lost my face: it no longer belonged to me, but had become an anonymous image, ready for co-optation.

Today I believe that one way to make the habitual whiteness of color test cards more apparent, is by insisting that these standard images that often are trapped in the histories of our technologies, become part of the public domain. These images need to lose their elusive power. The stories of standardization belong in high school textbooks, and the possible violence of standardization should be studied in any curriculum. By illuminating the histories of standardization, we will also see its white shadows.

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[57] Iozzo, Corinne. 'The Playboy Centerfold That Helped Create the JPEG. The story of a 1970s computer-science lab, a spare magazine, and one model's unlikely technological legacy,' in: *The Atlantic*, 2016.

365 Perfect Decalibration (2020)
Archival prints (5)

In 365 Perfect, Menkman turns to mobile imaging softwares. 365 Perfect is “the best FREE virtual makeup app, period. It’s like having a glam squad in your pocket” - or so states the software. In this humorous, yet discomforting work, Menkman layers the standard features of beautifying software on her own image, enlarging her eyes, deleting blemishes and enhancing features, until the original face is nearly unrecognizable. Over and over, Menkman alters her likeness, seemingly to make herself appear more conventionally beautiful and more “perfect”. Saving her image at every new iteration, she arrives at a re-compressed pixelated JPEG, and a grotesque, if not almost inhuman self-portrait.
365 Perfect is not only a commentary on the relationship between mobile technology and the beauty industry, but a careful exploration of resolution loss, and the visual artifacts that are created as a result.

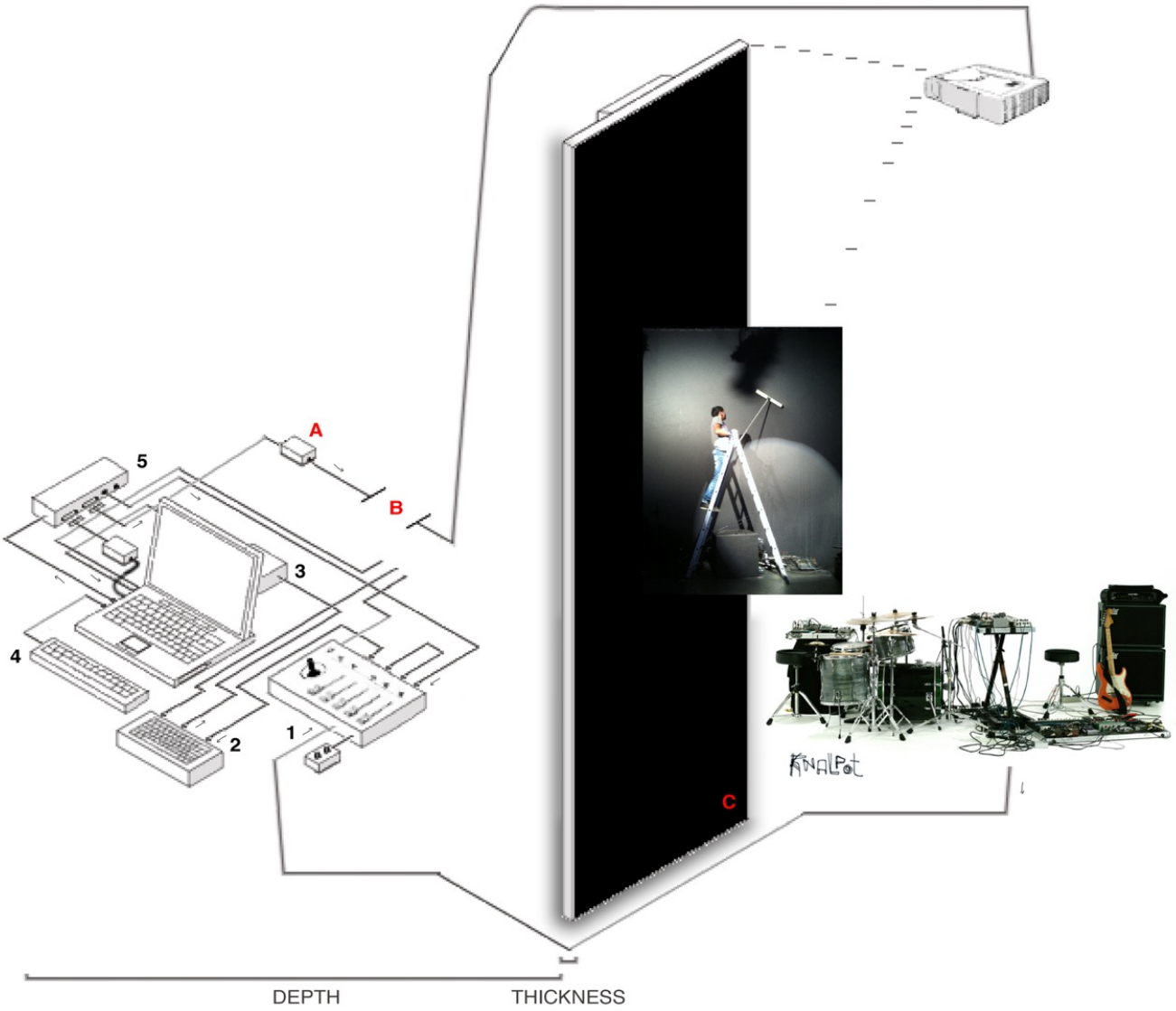
Unresolved (2020)

64 meters, 32x32x2 pixel file mounted on hardware

Inspired by the 2011 work Beyond Yes and No, by new media artist Beflix, Unresolved explores an alternative method of visualising data.

Reproducing two 32x32 pixel bitmap images, Menkman painted a 64 meter long tape, and then mounted the double sided work on hardware (a wooden frame).

Unresolved presents an image on one side and a jpeg compression on the other. The work illustrates that bitmap images are merely string of data that can be copied, pasted and otherwise altered. Through this work, Menkman explores the ways in which a bitmap file, when opened in different formats, can create alternate modes of reading.



Setup during the night of the unexpected.

1. Sound from Knalpot into circuit bent video mixer
2. Video mixer to subtitler
3. Canopus 110 (RCA to DV for computer)
4. Midi controller
5. VGA to RCA converter
[in: computer VGA. 2x out: to projector and to video mixer, to generate a feedback loop]
6. Feedback loop into circuit bent video mixer, mixed with sound from Knalpot

Not requested on rider:

A. Analogue to HDMI converter
B. Russian video police
C. A black screen, 'cleaned' for better reflection

The Night of the Unexpected

In February 2013, I was invited to play a concert with the Dutch band Knalpot during *The Night of the Unexpected,* which was to take place October, of the same year, in Moscow. The invitation came from the Russian government as part of a celebration of 100 years of trade with the Netherlands. Coincidentally, the event was timed just after the implementation of a federal law passed on June 29, 2013, banning all "propaganda" about non-traditional sexual relationships. Given the circumstances, and with international stipulations about boycotting the country, the question of artistic participation was starkly raised. Needing the money and not feeling comfortable cancelling an event that me and Knalpot had been working on for quite some months, I did not cancel — although in hindsight maybe I should have.

A mediator working for the Dutch embassy in Moscow helped us through the process of obtaining our visa. Besides the normal requests, he demanded a map of my setup, a rider (the list of technological needs – I requested an RCA (analog) connection and a list of gear. He also spoke about permitted AV behavior, referencing the new ban on propaganda. I had to explain my intentions, describing the generation of synced live video, by using the sound of Knalpot.

The Night of the Unexpected arrived. The venue was large and we set up in the middle on an island built of scaffolding. A big projector graced the prow of our island, pointing at a professionally suspended black screen. A technician handed me HDMI (digital, not the requested analogue RCA), and an analog-to-digital converter. Surprised by a seemingly rapid accumulation of problems, I turned to the event's producer:

< Where will I project?
> This is the screen (pointing at the black screen)
< Ah I see…
I need to project on a white screen, will there be a white screen?
> In your rider it did not specify a white screen.
< A black screen will not reflect the light; it will absorb light, which means the projection will not show.
I think we really need a white screen.
> I ordered the best technology in Moscow. It is the most expensive.
(silence)
< Can I show you what I mean? We can test it by projecting onto it.
… Could I please have the RCA I requested in my rider?
> (producer points at HDMI cable and analog-to-digital converter)
We have this for you. It's better, it's digital.
< Oh…

I requested analogue out. It is better for me.
> HDMI is better resolution.
< I need to send my analogue output unconverted, from my synthesizer to the projector, to keep it untransformed and synced with the music the band is playing.
> Analogue is not possible. We have HDMI.

With none of my initial issues resolved I entered the rehearsal only to encounter an even bigger problem: in the corner of the island, next to a video server, a Russian video engineer (member of what I would dub the "Russian video police") was screening my live video for offensive content, taking the liberty to overlay or even cut my stream at any time. The digital video server of the Russian video police digitized my analog and synced the video stream, not only corrupting its intrinsic analogue qualities by replacing analogue scanning (line) artifacts with digital macroblocks — introducing an aspect ratio conflict (the video got stretched) — but also its timing, by adding a two-second delay. By the end of this process, my performance became a barely visible, un-synced and wrangled disaster.

Resolving the Image Off-Screen

I then realized that even though a screen often illuminates a situation, what happens beyond the screen is obscured by that same screen. The screen acts as a veil, covering one part of the technology as a Japanese Shoji screen divides a room, *concealing* (most of) the technological processes involved in resolving the image.[58]

Further, it demonstrated shortcomings in my use and understanding of the term *resolution*. During the performance the differences between the resolved image on the black screen visible to the audience, and the image resolved on my check monitor differed not just in terms of brightness or aspect ratio, but also in terms of aesthetics, timing, and most importantly, in terms of *power*.

Thus, the term resolution needs to be expanded to encompass more than just the dimensions of the screen or display — a final resolution is, after all, not just a matter of width and height. A critical reflection of a screens' resolution considers the technological procedures and trade-offs a programmer or artist has to deal with

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58 Shoji screens are made of a traditional paper called washi, consisting of fibers from the kozo tree. Washi paper has a specific thinness that allows just the right amount of light to go through: "By changing the fiber direction and thickness, washi can control two opposing optical factors such as reflection rate and transparency. Shoji's paper surface scatters sunlight evenly, making it soft to the eye and allowing light to distribute evenly. […] Even at night, Shoji screens help light a room as their white surface reflects indoor light and brightens the room. Shoji paper is thus quite remarkable: it has no glare problem, maintains privacy, and allows the light to enter in a pleasant way."

Sukiya Living Magazine, "Shoji Screens," 2004.
see: http://www.rothteien.com/superbait/shojiscreens.htm

beyond (or behind) the screen, i.e., the power relations and standardizations involved in creating or resolving a final image on the screen. In his thesis *Movie/ Cinema: Rearrangements of the Apparatus in Contemporary Movie Circulation*, Gabriel Menotti Miglio Pinto Gonring writes:

> Screens are normally treated as mere flat surfaces, composed of only height and width. One talks about their area, aspect ratio and resolution, as if these characteristics were all that mattered to the screen. Nevertheless, to be able to hold an image, the screen must have some density and in order to be dense, the screen has to be thick. Given this implies solidity and opacity, the thickness accounts for the most material aspect of the screen. It means that, if it is in the wrong position, the screen can actually hide the image from the gaze.[59]

The question is, what is this depth of the screen and what does it obfuscate and show — what, in other words, are the qualities and compromises of the process of resolving the image on and off-screen?

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59 Gonring, Gabriel Menotti Miglio Pinto, *Movie / Cinema: Rearrangements of the Apparatus in Contemporary Movie Circulation.* Doctoral thesis, Goldsmiths, University of London, 2011: p. 227.
see: http://research.gold.ac.uk/6604/ (20.02.20)

Refuse to Let the Syntaxes of (a) History Direct Our Futures

Moving Beyond Resolution

I wish I could open Google image search, query “rainbow,” and simply listen to any image of a rainbow Google has to offer me. I wish I could add textures to my fonts and that I could embed within such text videos that would play at particular moments. I wish I could render and present my videos as circles, pentagons and other more organic manifolds. If I could do these things I believe my use of the computer would be different: I would create modular relationships between my text files and my videos would have uneven corners, multiple time

Screenshot of QTzrk (2011) by Jon Satrom

In 2011, Chicago glitch artist Jon Satrom released the video installation *QTzrk*. Technically, *QTzrk* consists primarily of two video elements. The first element, a 16:9 video, captured from a desktop perspective features a movie.mov file. The movie.mov is shown on top of the desktop, an environment deconstructed by *QTzrk*. The second type of video elements are Qtlets: smaller, looped videos, which are not quadrilateral. QTlets are constructed and opened via a now obsolete option in Quicktime 7 software. Using this option, Satrom employed a mask to change the shape of the otherwise four-cornered videos, transforming them into "video shards." QTlet elements are featured in *Qtzrk,* but are also released as stand-alone downloadables, available on Satrom's website. Unfortunately, they no longer play properly on recent versions of Mac OS X as the masking option is now obsolete, which makes playing these files a challenge.

Story-wise, *QTzrk* begins when the movie.mov file is clicked. It opens inside a Quicktime 7 player, on top of what will later become visible as a clean desktop without a menu bar. Movie.mov shows a slow motion nature video of a great white shark jumping out of the ocean. Suddenly, a pointer clicks the pause button on the interface, and the Great White Shark turns into a fluid video, leaking out of the Quicktime 7 movie.mov interface. The shark folds up in a kludgy pile of video, resting on the bottom of the desktop, still playing, but now in a messily folded way. The Quicktime 7 movie.mov window changes into what looks like a terminal and is then commanded to save itself as a QTlet named "shark_pile." The shark_pile is picked up by a mouse pointer, which kind of performs like an invisible hand, hovering the pile over the desktop, finally dropping it back into the Quicktime window, which now shows line after line of mojibake data. This action — dropping the shark_pile inside the Quicktime window — seems to be the trigger for the desktop environment to collapse.

The Quicktime player breaks apart, no longer adhering to its quadrilateral shape, it now assumes the form of a second, downloadable, QTlet. On the desktop, 35 screenshots of the shark frame appear. A final new QTlet is introduced, this one consists of groups of screenshots, which when opened show glitched png files. These clusters themselves transform into new video sequences (a third downloadable QTlet), adding more layers to the collage. By now the original movie.mov seems to slowly disappear in the desktop background — itself featuring a data-moshed shark video (data-moshing is the colloquial term for the purposeful deconstruction of an .mpeg, or any other video compression using intraframe/keyframe standards). After a minute of noisy droning of the QTlets on top of a data-moshed shark, the desktop suddenly starts to zoom out, revealing one Quicktime 7 window inside the next. Finally, the cursor clicks the close button in the Quicktime 7 interface, ending the presentation and revealing a clean white desktop with just the one movie. mov file icon in the middle. Just when the pointer is about to reopen the movie.mov file, and start the loop all over again, *QTzrk* ends.

TITLE: QTzrk — DIMENSIONS: expandable/variable — MATERIALS: QuickTime 7
YEAR: 2011 — PRICE: FREE

lines and changing soundtracks. In short, I think my computational experience could be much more like an integrated collage if my operating system would allow me to *make it so*.

The installation, consisting of four different video loops, introduced me to both the genre of desktop film and to non-quadrilateral video technology. As such, it left me both shocked and inspired. So much so that, in 2012, inspired by Satrom's work, I set out to build *Compress Process*, an application that would make it possible to navigate video inside a 3D environment. I too wanted to stretch the limits of video, especially beyond its quadrilateral frame. However, upon release of *Compress Process*, Wired magazine reviewed my video experiment, calling it a "flopped video game."[60] Ironically, the Wired reporter could not imagine video existing outside the confines of its traditional two-dimensional, flat, and standardized interface. From his point of view, this other resolution, 3D, signified a specific categorization of the work as a game rather than a video application and as such, it was reviewed (and burned) as 'a flop'.

This type of imposition on the interface is extensively described by NYU new media professor Alexander Galloway in his book *The Interface Effect*. Galloway writes that "an interface is not a thing, an interface is always an effect. It is always a process or a translation."[61] The interface thus always becomes part of the process of reading, translating and understanding of our mediated experiences. When considered in this light, one can make sense of the reviewer's reaction to *Compress Process*. Such a situation prompts the question of whether it is at all possible to escape the normative or habitual interpretation of the interface?

As Wendy Hui Kyong Chun writes, "New media exist at the bleeding edge of obsolescence. […] We are forever trying to catch up, updating to remain (close to) the same."[62] Today, the speed of the upgrade has become incommensurable: new upgrades arrive too fast and even seem to exploit this speed as a way to obscure their new options, interfaces, and (im)possibilities. Because of the speed of the upgrade, remaining the same, or using technology in a continuous manner, has become a mere aspiration. Chun's argument seems to echo what Deleuze had already described in his 'Postscript on the Societies of Control':

> Capitalism is no longer involved in production […] Thus it is essentially dispersive, and the factory has given way to the corporation. The family, the school, the army, the factory are no longer the distinct analogical spaces that converge toward an owner — state or private power — but coded figures — deformable and transformable — of a single corporation that now has only stockholders. […] The conquests of the market are made by grabbing control and no

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60 Klatt, Oliver. '*Compress Process*' in: *Wired Germany edition*, January 2013: p. 106–107.

61 Galloway, Alexander R. *The Interface Effect*. Cambridge: Polity Press, 2012: p. 33.

62 Chun, Wendy Hui Kyong. *Updating to Remain the Same: Habitual New Media.* Cambridge: MIT Press, 2016: p. 1.

> longer by disciplinary training, by fixing the exchange rate much more than by lowering costs, by transformation of the product more than by specialization of production.[63]

In other words, the continuous imposition of the upgrade demands a form of control over the user, leaving them with a sense of freedom, while they effectively become more and more restricted in their practices. Today, the field of image processing forces almost all formats to follow quadrilateral, ecology dependent, standard (re)solutions, which result in trade-offs (compromises) between settings that manage speed and functionality (bandwidth, control, power, efficiency, fidelity), while at the same time considering claims in the realms of value vs. storage, processing, and transmission. At a time when image-processing technologies function as black boxes, we desperately need to research, reflect, and re-evaluate our technologies of obfuscation. Yet, institutions — schools and publications alike – appear to consider the same old settings over and over, without critically analyzing or deconstructing the programs, problems, and possibilities that come with newer media. As a result, there exists no support for the study of (the setting of) alternative resolutions. Users just learn to copy the use of the interface, to paste data and replicate information, but they no longer question, or learn to question, their standard formats.

Mike Judge made some alarming forecasts in his 2006 science fiction comedy film *Idiocracy,* which, albeit indirectly, echos science fiction writer Philip K. Dick's dystopian short story 'Pay for the Printer' (1956). In an era in which printers print printers, everything slowly resolves into useless mush and *kipple*. In a way, we have to realize that if we do not approach our resolutions analytically, the next generation of our species will likely be discombobulated by digital generation loss — a loss of fidelity in *resolutions* between subsequent copies and trans-copies of a source. As a result, daily life will turn into obeying the rules of institutionalized programs, while the user will end up only producing monotonous output.

In order to find new, alternative resolutions and to stay open to refreshing, stimulating content, I need to ask myself: do I, as a user, consumer, and producer of data and information, depend only on my conditioning and the resolutions that are imposed on me, or is it possible for me to create new resolutions? Can I escape the interface, or does every decontextualized materiality immediately get re-contextualized inside another, already existing, paradigm or interface? How can these kinds of connections block or obscure intelligible reading, or actually offer me a new context to resolve information? Together these questions set up a pressing research agenda but also a possible future beyond monotonous data. In order to try to find an answer to any of these questions, I will need to start at the beginning with a genealogy of the term resolution.

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63 Deleuze, Gilles, 'Postscript on the Societies of Control,' in: *October*, (no.59, Winter 1992): p. 3–7.

Optical Resolution

To really get an insight into the complexity of resolution, I would like to use this section to describe some fundamental principles at the core of the basic formula for angular resolution, which hail from physics. Although they simply concern what the minimum angle necessary is to discern two points from each other, a much greater complexity is faced when such a formula is transposed into the realms of technology.

In 1877, the English physicist John William Strutt succeeded his father to become the third Baron Rayleigh. While Rayleigh's most notable accomplishment was the discovery of the inert (not chemically reactive) gas argon in 1895, for which he earned a Nobel Prize in 1904, Rayleigh also worked in the field of optics. Here he wrote a criterion that is still used today for quantifying angular resolution: the minimum angle at which a point of view still resolves two points, or the minimum angle at which two points become visible independently from each other. In an 1879 paragraph titled 'Resolving, or Separating, Power of Optical Instruments,' Lord Rayleigh writes: "According to the principles of common optics, there is no limit to resolving-power [of an instrument]."[64] But in a paper written between 1881 and 1887, Rayleigh asks: 'How is it […] that the power of the microscope is subject to an absolute limit […]? The answer requires us to go behind the approximate doctrine of rays, on which common optics is built, and to take into consideration the finite character of the wave-length of light."[65]

When it comes to straightforward optical systems that consider light rays only from a limited spectrum, Rayleigh was right: in order to quantify the resolution of these optical systems, the contrast — i.e. the amount of difference between the maximum and minimum intensity of light visible within the space between two objects — is indispensable. Just like a white line on a white sheet of paper needs contrast to be visible (to be resolved), it will not be possible to distinguish between two objects when there is no contrast between these two objects. Contrast between details defines the degree of visibility, and thus resolution: no contrast will result in no resolution.

But the contrast between two points, and thus the minimum resolution, is contingent on the wavelength of the light and any possible diffraction patterns between those two points in the image. The ring-shaped diffraction pattern of a point light (a light source), known as an Airy Pattern (named after George Biddell Airy), is the result of diffraction and is characterized by the wavelength of light illuminating a circular aperture. When two light points are moved into close proximity — so close that the first Airy disk's zero crossing falls inside the second Airy disk's zero crossing — the oscillation within the Airy Patterns will cancel most contrast of light

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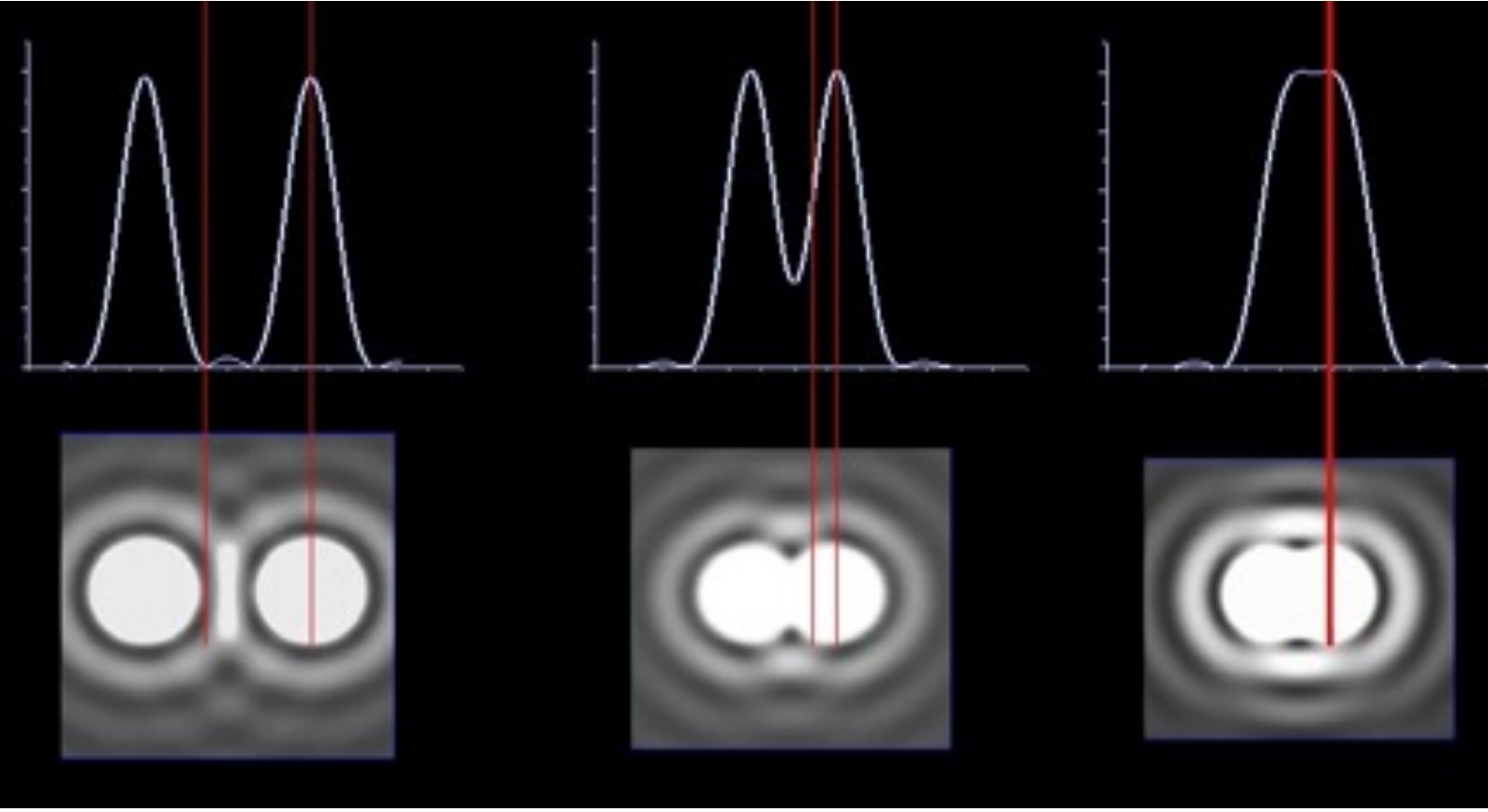
64 Rayleigh, Lord, 'XXXI. Investigations in Optics, with Special Reference to the Spectroscope,' in: *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, (no. 8, 1879): p. 261–74.

65 John William Strutt, Baron Rayleigh, 'On the electromagnetic theory of light,' in: *Scientific Papers*, Vol II, 1881–1887. Cambridge University Press, 1900: p. 410.



(a) Two monochromatic light sources pass through a small circular aperture and produces a diffraction pattern. (b) Two point light sources that are close to one another produce overlapping images because of diffraction. (c) Two light sources move so close together, that they cannot be resolved or distinguished.

between them. As a result, the two points will optically be blurred together, no matter the lens' resolving power. Thus: even the biggest imaginable telescope has limited resolving power.

Rayleigh described this effect in his Rayleigh criterion, which states that two points can be resolved when the center of the diffraction pattern of one point falls just outside the first minimum diffraction pattern of the other. When considered through circular aperture, Rayleigh states that it is possible to calculate the minimum angular resolution (the minimum distance between two points or light sources) as:

$$\theta = 1.22 \lambda / D$$

In this formula, θ stands for angular resolution (which is measured in radians), λ stands for the wavelength of the light used in the system (blue light has a shorter wavelength, which will result in a better resolution), and D stands for the diameter of the lens' aperture (the hole with a diameter through which the light travels). Aperture is a measure of a lens' ability to gather light and resolve fine specimen detail at a fixed object distance.

A smaller resolution thus means there is a smaller resolution angle (and thus less space) necessary between the resolved dots. However, real optical systems are complex and suffer from aberrations, flaws in the optical system and practical difficulties such as specimen quality. Besides this, in reality, most often, two dots radiate or reflect light at different levels of intensity. This means that in practice the resolution of an optical system is always higher (worse) than its calculable minimum.

All technologies have a limited optical resolution, which depends on, for instance, aperture, wavelength, contrast and angular resolution. When the optical technology is more complex, the actors that are involved in determining the minimal resolution of the technology become more diverse and the setting of resolution changes into a more elaborate process. In microscopy, just like in any other optical technology, angular and lateral resolution refer to the minimum amount of distance needed (measured in rads or in meters) between two objects, such as dots, that still make it possible to tell them apart. However, a rewritten mathematical formula defines the theoretical resolving power in microscopy as:

$$\mathbf{dmin = 1.22 \times \lambda / NA}$$

In this formula, d_{min} stands for the minimal distance two dots need from each other to be resolved, i.e. their minimal resolution. λ stands again for the wavelength of light. In the formula for microscopy, however, the diameter of the lens' aperture (D) is swapped with NA, or numerical aperture, which consists of a mathematical calculation of the light-gathering capabilities of a lens. In microscopy, this is the sum of the aperture of an objective and the diaphragm of the condenser, which have set values per microscope. Resolution in microscopy is thus determined by certain physical parameters that not only include the wavelength of light, but also the light-gathering power of the objective and the lenses.

The definition of resolution in this second formula is expanded to also include the attributed settings of strength, accuracy, or power of the material agents that are involved in resolving the image: the objective, condenser and lenses. At first sight, this might seem like a minimal expansion and lead to the dismissal of a simple rephrasing or rewriting of the earlier formula for angular resolution. However, the expansion of the formula with just one specific material agent, the diaphragm, and the attribution of certain values of this material agent (which are often determined in increments rather than a fluid spectrum of values) is actually an important step that illustrates how technology gains complexity. Every time a new agent is added to the equation, the agent introduces complexity by adding their own rules or possible settings; involving or influencing the behavior of all other material agents. Moreover, the affordances of these technologies, or the *clues* inherent to how the technology is built to tell a user how it can or should be used, also play a role that intensifies the complexity of the resolution of the final output. As James J. Gibson writes, "affordances are

properties of things taken with reference to an observer but not properties of the experiences of the observer."[66] In 1975, Estes and Simonett describe resolution in their paper 'Fundamentals of Image Interpretation' as

> the ability of an imaging system […] to record fine detail in a distinguishable manner.[67] While resolution is often understood in terms of spatial resolution — the fineness of the details visible in an image — but there are many different types of resolution: temporal resolution (the speed of the sequence in which images are recorded) or radiometric resolution — the recording of different levels of brightness. Users can decide on the trade-offs between different types of resolution, for instance - a high temporal resolution might result in a lower range in brightness, while high contrast favours recording of fine spatial detail. "In very broad terms, resolution refers to the ability of a […] sensing system to record and display fine spatial, spectral, and radiometric detail." A working knowledge of resolution is essential for understanding both practical and conceptual aspects of […] sensing.[68]

Our understanding, or lack of understanding, of resolution may be the limiting factor in our efforts to use data and understand its underlying value systems. In photography, for instance, the higher the aperture, the shallower the depth of field, the closer the lens needs to come to the object. This also introduces new possibilities for failure: if the diaphragm does not afford an appropriate setting for a particular equation, it might not be possible to resolve the image at all — the imaging technology might simply refuse or even state an 'unsupported setting' error message; in which case the technological assemblage will refuse to resolve an image entirely — the foreclosure of an abnormal option rather than an impossibility. Thus, the properties of the technological assemblage that the user handles, the affordances, add complexity to the setting of a resolution.

Aspect Ratio, Resolution, and Resolving Power

In optical systems, the quality of the rendered image depends on the resolving power and acutance of the technological assemblage that renders the image; the (reflected) light of the source or subject that is captured; and the context and conditions in which the image is recorded. Consider, for instance, how different objects (lens, film, image sensor, compression algorithm) have to weigh (or dispute) between standard settings (frame rate, aperture, ISO, number of pixels and pixel aspect ratio, color encoding scheme, or weight in mbps), while

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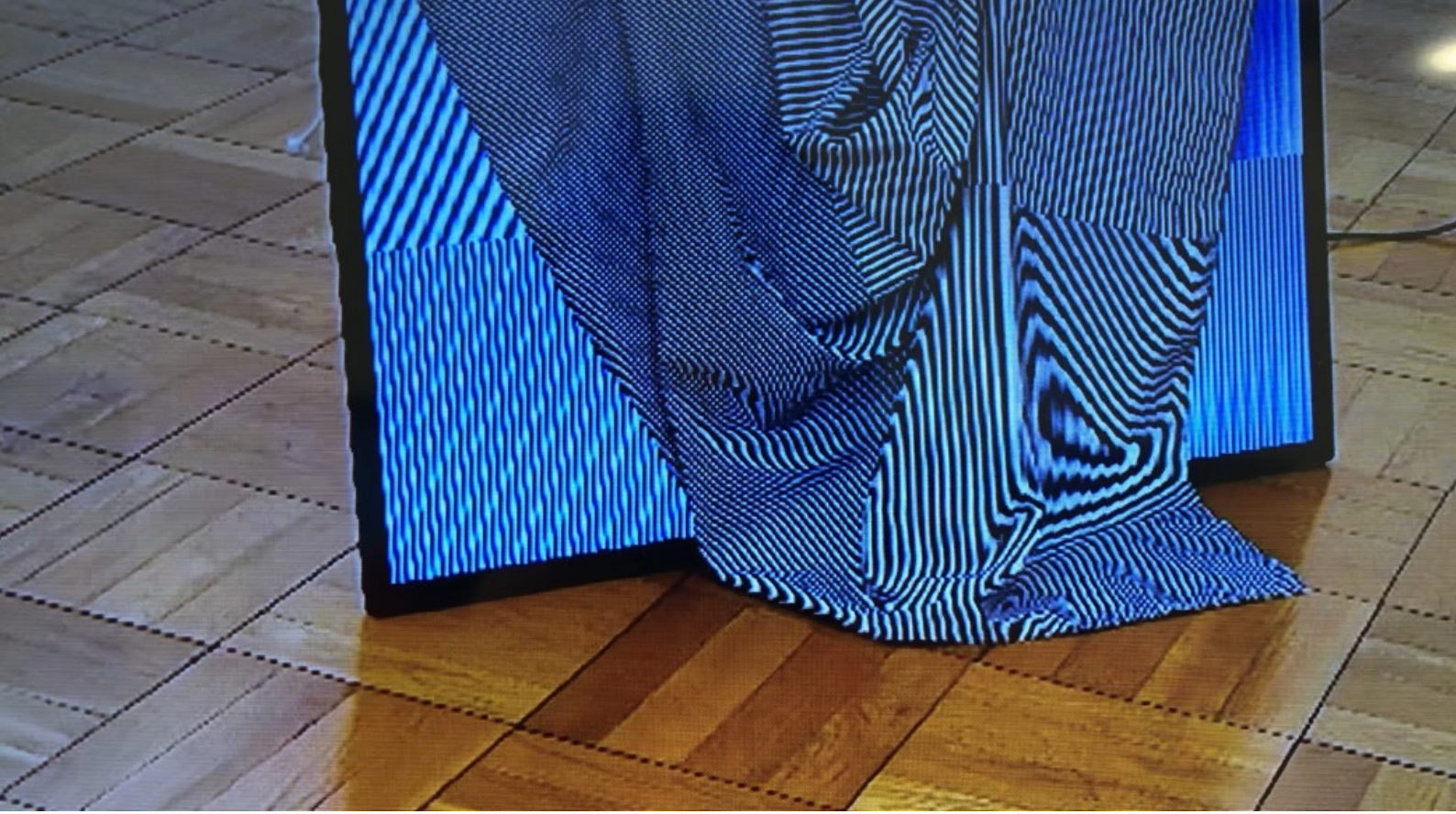
66 Gibson, James J. *The Ecological Approach to Visual Perception.* Hillsdale, NJ: Lawrence Erlbaum, 1986. see: http://smithiesdesign.com/wp-content/uploads/2016/09/05-Gibson-Theory-of-affordances.pdf.

67 Estes, John E., and David S. Simonett. 'Fundamentals of image interpretation - Manual of remote sensing,' in: *American Society of Photogrammetry* (1975): p. 879.

68 Campbell, James B. and Randolph H. Wynne. *Introduction to Remote Sensing.* New York: Guilford Press, 2011: p. 285.



Supercritical (2019) by UCNV: Video displayed on a monitor with high resolving power. Due to the down scaling of the source material, heavy interpolation artifacts and as a result, moire appeared. What is finally resolved is a HD, high acutance video with low fidelity.

also having to evaluate the technologies' possible affordances: the possible settings the mediating technological architecture offers when connecting or composing these objects and settings. Finally, the resolving power is an objective measure of resolution, which can, for instance, be measured in horizontal lines (horizontal resolution) and vertical lines (vertical resolution), line pairs or cycles per millimeter. The image acutance refers to a measure of sharpness of the edge contrast of the image and is measured following a gradient. A high acutance means a cleaner edge between two details while a low acutance means a soft or blurry edge.

Following this definition of optical resolution, digital resolution should — in theory — also refer to the pixel density of the image on display, written as the number of pixels per area (in ppi or ppcm) and maybe extended to consider the apparatus, its affordances, and settings (such as pixel aspect ratio or color encoding

schemes).[69] However, in an everyday use of the term, the meaning of digital resolution is constantly confused or conflated to simply refer to a display's standardized output or graphics display resolution: the number of distinct pixels the display features in each dimension (width and height). As a result, resolution has become an ambiguous term that no longer reflects the quality of the content that is on display. The use of the word 'resolution' in this context is a misnomer, since the number of pixels in each dimension of the display (e.g. 1920 × 1080) says absolutely nothing about the actual pixel density: the pixels per unit or the quality of the content on display, which may in fact be zoomed, stretched, letter-boxed or incorrectly color encoded, to fit the standard display resolution.

Moreover, by following a genealogy of the screen, one will find that this quantitative measurement of the quadrilateral screen has lost all references to its origins: early cathode ray tubes (CRTs) were circular. This was because the electron guns that shoot electron beams at the screen are stronger when made in a round shape. As to fit the picture better to the rectangular grid of the raster scan, television tubes gradually became rectangular.[70] While projection mapping hardware and software can be used to turn irregularly shaped objects into a display or *controlled* surface for video projection — regardless of the size or shape of their content — 99% of all digital screens are still quadrilateral and follow a standard shape and aspect ratio.

Besides the historical lineage of the cathode ray tube screen, another reason for the now consistent quadrilateral shape is that most screens are produced in China where Plasma, LCD, LED and OLED screens are cut from large sheets in a line and en masse. Only recently exceptions to the quadrilateral frame have slowly been invading the market. For instance, the flexible LED screen, the holographic led fan display, or the LED screens that are constructed out of multiple panels or strips, which can be clicked and connected together irregularly.

But we are not entirely stuck in the box: with the release of the iPhone X in late 2017, a new future for the (non-quadrilateral) screen came to the market: the iPhone "Super Retina display" features not just rounded corners, but a "notch": a cut-out for the housing of its sensors. Funny enough, in Apple's Human Interface Guidelines, the brand advises its developers to establish the notch trademark as follows: "Don't mask or call special attention to key display features. Don't attempt to hide the device's rounded corners, sensor housing, or indicator for accessing the Home screen by placing black bars at the top and bottom of the screen. Don't use

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69 The importance of the resolution of color encoding has been described in detail by Carolyn Kane in her book: Kane, Carolyn. *Chromatic Algorithms: Synthetic Color, Computer Art, and Aesthetics after Code.* Chicago: University of Chicago Press, 2014.

70 On a side-note, a recent wave of children's Sci-Fi movies re-introduced circular and elliptical (or non quadrilateral) screens; a resolution that could be read as a reference to the now often forgotten electronic history of the (round) screen, such as in spy and radar technologies.
Examples of this can be found in my Lexicon of Glitch Affect (2019)
see: https://beyondresolution.info/A-Lexicon-of-Glitch-Affect (20.02.20)

visual adornments like brackets, bezels, shapes, or instructional text to call special attention to these areas, either."[71] A story of how compromise became a feature...

Even so, the shape and proportions of the digital screen or the frame in which the screen rests, are still most often quadrilateral. Although there are many possible different aspect ratios and resolutions, there are only a few *standard* aspect ratios and resolutions. The aspect ratio of a standard home screen in 2018 was16:9, while its predecessor (before 2010) was 4:3. Despite experimentation within the fields of cinema and video, generally, screens are confined to these two aspect ratios. When content does not fit the aspect ratio of the screen, a technique called letterboxing or "stylized pillarboxing" may be used, adding black or blurred bars on both sides, to center and make the content fit or fill the screen. Only in 2018, did the YouTube Player window give up its rigid — and quite artificial — default aspect ratio. From then on videos would no longer be scaled into a 16:9 playback mask, instead adapting to the dimensions of a clip. A video in 4:3 is no longer played with black bars on the side, but rather uses the full available width or height. This might have been to give way for the growing popularity of vertical video, or the come back of the nostalgic 4:3 format.

We can see from this example of Youtube pillar-boxing, how often historical settings either ossify as requirements or de facto norms, or are notated as *de jure*, legally binding, standards by organizations such as the International Organization for Standardization (ISO). While this makes the process of resolving an image less complex — systematizing parts of the process — ultimately it also makes the process less transparent and more black-boxed. And it is not only institutions such as ISO that program, encode, and regulate (standardize) the flows of data in and between our technologies, or that arrange the data in our machines following systems that underline efficiency or functionality. In fact, data is organized following either protocol or proprietary standards developed by technological oligarchs to include all kinds of inefficiencies that the user is not conditioned or even supposed to see, think, or question. These proprietary standards function as a form of control. By re-encapsulating our information inside various wrappers that (re-)encode, edit, and even deform our data we are subjected to a type of corporate nepotism, and (sometimes) covert cartel operations who impose insidious data collection policies and even lock users into their proprietary software.

Just as in the realm of optics, a resolution does not just mean a final rendition of the data on the screen, but also involves the processes and affordances involved during its rendition — the trade-offs inside the technological assemblage which record, produce, and display the image (or other media, such as video, sound, or 3D data). The current conflation of the meaning of resolution within the digital — as a result of which resolution only refers to the final dimensions the image is displayed at or in — obscures the complexities and politics at stake in the process of resolving. In consequence, limits are imposed on our understanding of the use, compilation and reading of (imaging) data. In short, further theoretical refinements that elaborate on the usage and development of the term resolution have been missing from debates on resolution from the moment of its

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71 'Human Interface Guidelines,' Apple Developer website.
See: https://developer.apple.com/ios/human-interface-guidelines/overview/iphone-x/ (20.02.20)

importation from the field of optics, where it has been in use for two centuries. As such, to garner a better understanding of our imaging technologies, the word resolution itself needs to be resolved; or rather, it needs to be disentangled to refer not just to a final output, but to a more procedural construct.

ntie&&Dis/Solve: Digital Resolutions

Resolutions are man-made. Constrained by the procedural trade-offs between the affordances of hardware and software settings; the more complex an image-processing technology is, the more actors its rendering entails — each following their own rules or standards to resolve an image. However, these actors and their inherent complexities are increasingly positioned beyond the fold of everyday settings, outside the options represented inside the interface. As such, resolutions are not just an interface effect but also a hyperopic lens, obfuscating possible alternative forms to resolve data — whether it be an image, a video or a sound.

Unknowingly, the user and audience suffer from technological hyperopia: a state of farsightedness that prevents the user from seeing the processes taking place directly under their nose. Hyperopia is the result of one's exclusive focus on the final end product. This is a consequence of the shift from user created resolutions, to the setting of resolutions and, finally, to the imposition of resolutions as standard settings. Every time we press print, run, record, publish, render, we also press "compromise." Unfortunately, however, what we compromise — settings between or beyond our standards, and which deliver other, maybe unwanted, but maybe also desirable outcomes — is often obfuscated. We hence need to shift our understanding of resolutions, seeing them as disputable norms, habitual compromises and expandable limits. By challenging the actors involved in establishing resolution settings, the user can scale actively between increments of hyperopia and myopia. The question is: has the user become unable to construct their own settings, or has the user simply become oblivious to resolutions and their inherent compromises? It is also to ask how the user became this blind?

One answer to this question can be found in a redefinition of the screen. Today, the term "screen" may still refer to its old configuration: a two-dimensional material surface or threshold that partitions one space from the next, or functions as a shield. As curator and theorist Christiane Paul writes, the screen acts as a mediator of (digital) light.[72] However, over the past decades, technological innovations have transformed the notion of the screen into a wide variety of complex amalgamations.

In *The Language of New Media* (2002), Lev Manovich offers a short genealogy of the screen, distinguishing three different types. The first screen he describes as the "classical screen": a static, pictorial screen or painting. The second type of screen Manovich calls the "dynamic screen": television, moving images, video. A third and more complex screen that Manovich recognizes is the interactive "screen of real time." This

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[72] Paul, Christiane. 'Mediations of Light: Screens as Information Surfaces,' in: *Digital Light*, ed. Sean Cubitt, Daniel Palmer, and Nathaniel Tkacz. London: Open Humanities Press, 2015: p. 179–92.

type of screen is still in development and includes radar, computer, telephone and VR screen technologies.[73] In "Elements of Screenology," Erkki Huhtamo writes:

> in spite of their ubiquitous presence screens are strangely evasive, hard to grasp. They are constantly metamorphosing, appearing in new places and new forms. There are "Big Screens" and "Small Screens." Some are flat, some fat, attached to a box. Some are like the sun — active, radiating "life" of their own — while others are like the moon, passive, reflecting light projected at them. There are screens observed from a distance, and others touched and interacted with, held in one's hand. How to formulate a definition that would embrace them all? Does it even make sense to ask such a question?" he moves on writing: "Screens should not be studied in isolation of the apparatus they are part of. The notion of apparatus comes from cinema studies: it comprises not only the technical system, but also the elements of the viewing situation, including the relationship between the screen and the viewer, which is both physical and imaginary."[74]

While some screens are still volatile and "should not be touched" or at least "handled with care," modern screens generally consist of a layer that can be touched, and are thus considered "touch screen." These now pervasive interactive screens, with two-finger-touch or multi-touch sensitivity, allow the user to zoom in and out on information. Yet this is not the only way the smartphone's touch screen has changed screen technology. Today, almost the entire mobile phone is covered by the screen, transforming the experience of the phone into an entirely screen based, "mobile device." These direct, responsive qualities — further advanced by built-in accelerometers — have ignited qualitative shifts. In the iPhone, the accelerometer is responsible for lighting up the screen when the phone is picked up, or rotating it toward the users point of view. As a result, the screen no longer has a standard orientation — requirements for content scale automatically and are "responsive." The mobile device is now a black mirror when inactive, and a space of representation when active.

Further, the screen has transformed into a navigational plane, rendering it similar to an interface or GUI. Huhtamo dabbles with the possibility of describing the contemporary screen as a framed surface or container for displaying visual information that is controlled by the user and therefore not permanently part of the frame. He finally argues that the screen exists as a constantly changing, temporally constructed interface between the user and information.[75] The screen of the mobile device consists of different elements — such as widgets, apps

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73 Manovich, Lev. *The Language of New Media.* MIT press, 2001: p. 95–103.

74 Huhtamo, Erkki. 'Elements of Screenology,' in: *ICONICS: International Studies of the Modern Image*, (Vol.7, 2004): p. 31–82.

75 Huhtamo, Erkki. 'The Pleasures of the Peephole: An Archaeological Exploration of Peep Media,' in: *Book of Imaginary Media: Excavating the Dream of the Ultimate Communication Medium.* NAi Publishers, 2007: p. 74–155.

and shortcuts — and also spatial and temporal units. As Galloway explains in *The Interface Effect*,[76] the interface is part of the processes of understanding, reading and translating our mediated experiences: it operates as an effect. In his book *The Interface Envelope*, James Ash writes:

> within digital interfaces, the specific mode of resolution of an object is carefully designed and tested in order to be as optimal as possible […]. In a digital interface, resolution is the outcome of transductions between a variety of objects including screened images, software, hardware, and physical input devices, all of which are centrally involved in the design of particular objects within an interface.[77]

Not only has the screen morphed from a flat surface to an interactive plane of navigation, the technologies that shape its content have developed into extremely complex systems. As Manovich wrote back in 1995, "Rather than being a neutral medium of presenting information, the screen is aggressive. It functions to filter, to screen out, to take over, rendering nonexistent whatever is outside its frame."[78] The screen is thus not simply a boundary plane. It has become an autonomous object that affects what is being displayed; a threshold mediating different systems or a process oscillating between states. The mobile screen itself is located in-between different applications and uses.

In the computer, most of the interactions with our interfaces are mediated by software applications that act like platforms. These platforms do not take up the full screen, but instead exist within a window. While they all exist in the same screen, these windows follow their own sets of rules and standards; they exist next to and on top of each other like walled gardens. In a sense, these platforms are a modern version a framework: offering a simulacrum of freedom and possibility. In the case of the platform Instagram, for example, content is reformatted and deformed. Instagram recompresses and reformats any posted data, text, sound, or images, while it has rules for the number of characters, as well as what characters and compressions can be used or uploaded. On the Instagram platform, one can only post a URL in the profile section of the platform. Moreover, it saves content on its own server, making it accessible only via the platform. In short, Instagram enforces its own resolutions that range from formatting to accessibility. It is important to realize that the screen is in a constant state of assemblage: delimiting and demarcating our ways of seeing, while expanding the axial and lateral resolution to layers that are usually obfuscated or uncharted.

It is hence imperative to rethink the definition of resolution and expand it from a simple measure of acutance. What is resolved on the screen and what is not depends not just on the material qualities of the screen

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76 Galloway, Alexander R. *The Interface Effect*. Cambridge: Polity Press, 2012.

77 Ash, James. *The Interface Envelope: Gaming, Technology, Power.* Bloomsbury USA, 2015: p. 35.

78 Manovich, Lev. 'An Archeology of a Computer Screen,' in: *Kunstforum International* (v.3, 1995): p. 124–135.

or display — or the signal it receives — but also on the processes, platforms, standards, and interfaces involved in setting these measures; behind or in the depths beyond the screen or display.

So while in the digital realm, the term resolution is often simplified to just mean a number – signifying the ability of a system to record and display fine spatial, spectral and radiometric detail or the width and height of a screen — the critical understanding of the term resolution I propose also considers *depth*. By depth I understand factors beyond the screen, which concern: audible technologies, protocols, and other (proprietary) standards, together with the technological interfaces and the objects' materialities and affordances, which together form a final resolution.

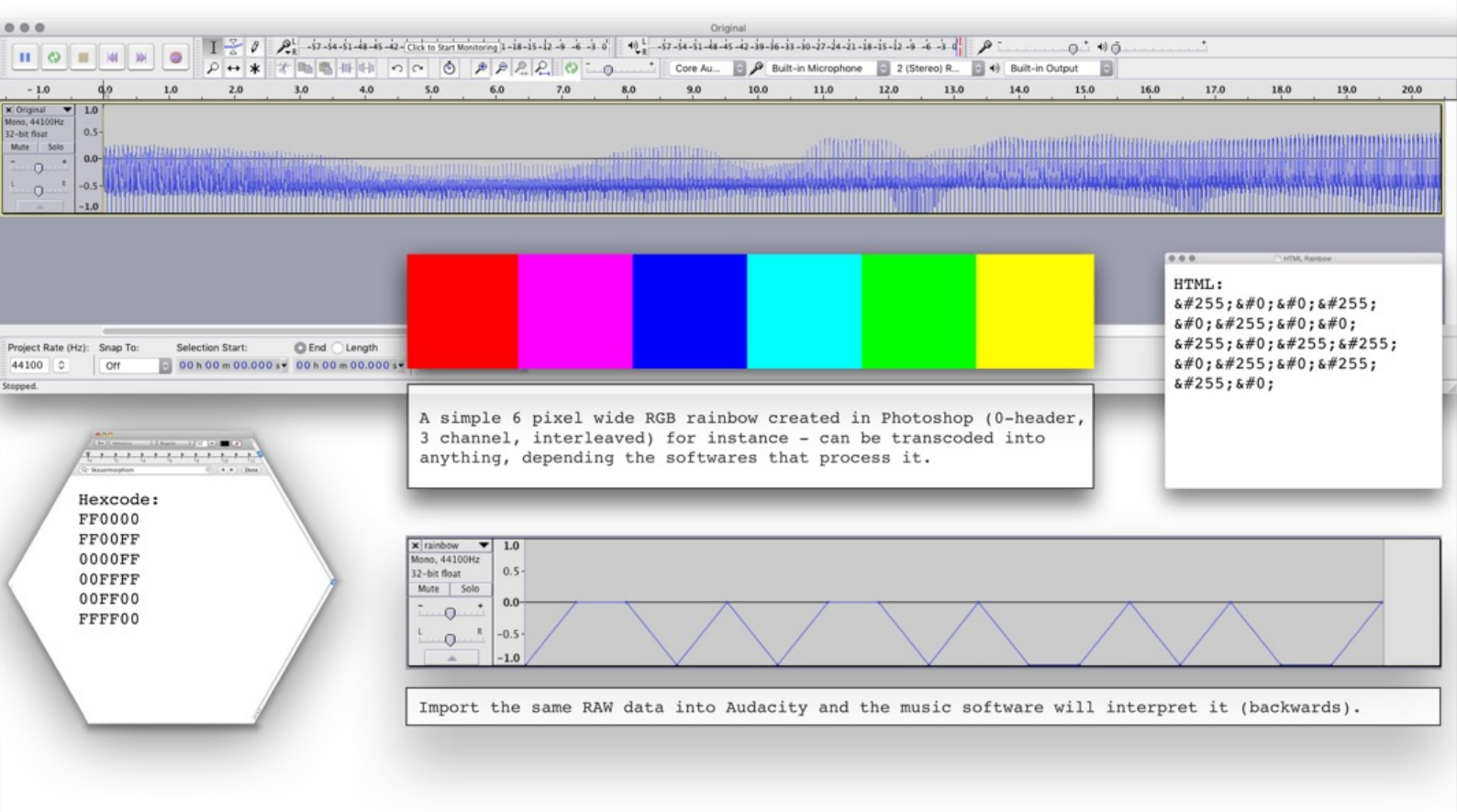
Depth thus conveys the position that resolution is never a neutral settlement, but an outcome that carries historical, economic and political ideologies, which were once implemented by choice. While resolutions compromise, obfuscate and obscure particular visual outcomes, the processes of standardization and upgrade culture as a whole also compromise particular technological affordances — creating new ways of seeing or perceiving — altogether. These alternative technologies of sight also need to be considered as part of Resolution Studies.

Rheology of Data

In 1941, the Argentinian writer Jorge Luis Borges published *El Jardín de senderos que se bifurcan* (The Garden of Forking Paths), which contains the short story 'The Library of Babel.' In this story, Borges describes a universe in the form of a vast library that contains all possible books which are generated following a few simple rules: every book consists of 410 pages, each page displays 40 lines and each line contains approximately 80 letters. Each book features any combination possible of the 25 orthographic symbols: 22 letters, a period (full stop), a comma, and a space. While the exact number of books in the Library of Babel can be calculated, Borges says the library is "indefinite and perhaps infinite."

The fascinating part of the story is Borges' description of the behavior of the library visitors. In particular, the "Purifiers," who arbitrarily destroy books that do not follow their rules of language and decoding. The word "arbitrarily" is important here, because it references the fluidity of the library: its openness to different languages and other systems of interpretation. One book may, for instance, offer an index to the next book, or a system of decoding: a "bridge" to read the next. This provokes the question: how do the Purifiers know they did not just read the books in the wrong order? How can they be certain that they were not just lacking an index or a codex that would help them access the books to be purified (burned)?

When I learned about NASA's use of sonification: the process of displaying any type of data or measurement as sound; I realized that with the right listening device, anything can be heard — even a rainbow. This does not always mean it makes sense to the listener, but rather, it is significant for the willingness of



contemporary space scientists to build bridges between different domains. I would later conceive of such bridges through the concept of a rheology of data.

Rheology is a term from the realm of physics, or, to be more precise, from mechanics used to describe the flow of matter — primarily in a liquid state, but also soft solids, or solids that respond in a plastic way; rather than deforming elastically in response to an applied force. By rheology of data I thus mean a study of how data can be read and displayed in completely different forms, depending on the context, software or interface. A rheology of data facilitates a deformation and flow of the matter of data; it demonstrates the possibility of pushing data into different applications and the presentation of data in different forms. In a sense, Limenia, the little antenna we used on the Brocken, is a hardware for rheology, because it transcodes one part of the electromagnetic spectrum (e.g. bluetooth or GPS) to the audible spectrum.

Thinking about the rheology of data became meaningful to me when I first ran the open source Mac OS X plugin technology Syphon (first released in 2010 as *open video tap*, but later developed by Anton Marini in collaboration with Tom Butterworth as Syphon). With the help of Syphon, I could suddenly make certain applications (Adobe After Effects, Modul8, Processing, or Open Frameworks) share information — such as full frame rate video or stills — with one another, in real time. Syphon allowed me to project my slides and video as

textures on top of 3D objects (from Modul8 to Unity). The plugin taught me that my thinking in software environments (as walled gardens) was flawed, or at least limiting. Software is much more interesting when it allows me to leak and push my content through its walls, which otherwise operate as closed architectures. Syphon hence showed me that data is more fluid than how we are conditioned to perceive and use it.

In the realm of computation, though, there is still very little fluidity. The 'Library of Babel' remains an asynchronous metaphor for our contemporary reality of computation. Computer programs only function when definite forms of formatted data are inserted: data for which the machine has codecs installed. (The value of) RAW, non-formatted or unprocessed data is easily dismissed because it is often hard to open or read. There seems to be hardly any freedom in transgressing this. The insights I gained from reading about NASA opened a new approach in my computational thinking: I started teaching my students not just about the electromagnetic spectrum, but also about how NASA, through sonification and other transcoding techniques, could listen to the weather. With such information I hoped they would understand the freedom they can take in the processes of perceiving and interpreting data.

Only the contemporary Purifiers — software, its users, and computer systems in general — enforce the rule that illegible data is invalid data. Take, for instance, Satrom's *QTlets*, which have, after a lifespan of a little over five years — at least in my OS — become completely obsolete and unplayable. In reality, it simply means that I do not have the right decoder, which is no longer available and supported. In general, it means that the string of data is not run through the right program or read in the right language, which would translate its data into a legible form of information. Data is not solid: it can flow from one context or environment to the next, changing both its resolution and its meaning. Such a capacity can be both a danger and a blessing in disguise.

Resolution Studies

Resolution theory is a study of literacy: literacy of the machines, the people, the people (engineers) creating the machines as well as the people being created by the machines. Resolution Studies is distinct in that it does not only involve the study of the *effects* of technological progress or the consequences of scaling — e.g., the habits and violences the come with particular settings of resolution — which have already been theorized in books by Alex Galloway[79] or Wendy Hui Kyong Chun[80]. Resolution studies also involves research on alternative settings that *could* have been in place, but that are not; as the affordances of technology have positioned certain settings outside of the domain of compatibility, these settings have been compromised.

Key to the study of resolutions is the realization that the condition of data is fluid. Every string of data is ambiguously promiscuous and has the potential to be manipulated into anything. This is how a rheology of data

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[79] Galloway, Alexander R. *The Interface Effect*. Cambridge: Polity Press, 2012.

[80] Chun, Wendy Hui Kyong. *Updating to Remain the Same: Habitual New Media.* Cambridge: MIT Press, 2016.

can support fluidity in data transactions: every piece of *information* functions within an environment that encodes and decodes, contextualizes and embeds data. In doing so, data gains meaning and becomes information. Different forms of ossification slither into every crevice of private life, while unresolved, ungoverned free space seems to be slipping away. Here we find the double edged sword of standardization: the power *and* dangers of standardization. The question then becomes how we move more easily beside or beyond these generally imposed flows of data? How, in other words, do we break away from these imposed, even imperialist, standards of resolution?

First of all, we need to realize that a resolution is more than a formal solution. Resolutions involve a technological (dis)entanglement and also an inherent compromise: if something is resolved one way, it is not resolved or rendered in another way. Determinations, like standard resolutions, are as dangerous as any other presumption: they preclude alternatives and perpetuate harmful or merely kludged and kippled procedures.

A resolution is the lens through which constituted materialities become signifiers in their own right. They resonate through the hive mind, constantly transforming our technologies into informed material vernaculars. As technology is evolving faster than we as a culture can come to terms with, determinations — such as standards — become threats in precluding choices we didn't even know existed. The radical digital materialist thus believes in "informed materials."[81] A term developed by B. Bensaude-Vincent and Isabelle Stengers and adopted and reworked by Susan Schuppli in her lectures on the "Material Witness*."* Matter is not just reshaped mechanically through chemical research and development, but is transformed into informed material: "Instead of imposing a shape on the mass of material, one develops an 'informed material' in the sense that the material structure becomes richer and richer in information. Accomplishing this requires a detailed comprehension of the microscopic structure of materials, because it is playing with these molecular, atomic, and even subatomic structures that one can invent materials adapted to industrial demands."

Schuppli uses the term informed material in congruence with the "material witness." According to Schuppli, material witness is a legal term that refers to someone who has knowledge pertinent to a criminal act or event that could be significant to the outcome of a trial. Schuppli goes on, "In my work, I poach the term 'material witness' to express the ways in which matter carries trace evidence of external events. But the material witness also performs a twofold operation; it is a double agent. The material witness does not only refer to the evidence of the event but also the event of evidence."[82] Schuppli goes on:

> It is insufficient to say that this specific type of material records or registers external events, because all material does that: with the right kind of analysis one can determine that my hand had been on the table,

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81 Bensaude-Vincent, B. and I. Stengers, *A History of Chemistry.* Harvard University Press, 1996: p. 206.

82 Menkman, Rosa and Lucas van der Velden, 'Dark Matters interview with Susan Schuppli,' in: *SONIC ACTS RESEARCH SERIES* #21: Nov 24, 2015. See: http://sonicacts.com/portal/dark-matters-an-interview-with-susan-schuppli

> but this does not make a material witness of the table. A material witness has to disclose the kinds of institutional frameworks and practices that are able to render the material witness significant. So in considering the material witness as both the evidence of the event and the event of evidence, it allows me to understand why certain events are deemed to be worthy of our attention, and other things are disregarded.[83]

Along similar lines then, it is important to understand what events have resolved, but also the event of resolve; it is not enough to understand what standards are used in a final resolution, but also how the standards have come into being and been resolved previously. The compression, software, platform, interface, and finally hardware such as the screen or the projector, all inform how a string of data is resolved; its presence, legibility and its meaning. They enforce and deform data into formatted or *informed materials*. The infrastructures through which we activate or access our data always engender distortions of our perception. Yet at the same time, because there is some freedom for the trickster using data's fluidity, the rightful meaning or "factuality" of data should always be open for debate.

Resolution Studies is not only about the effects of technological progress or the consequences of scaling. Resolution Studies is the study of how resolution as a material witness embeds tonalities into culture in more than just its technological facets. Moreover, from this point Resolution Studies can pivot on researching the standards that could have been in place, but are not. As a form of vernacular resistance, based on the concept of providing ambiguous resolutions, resolution studies can employ the liminal resolution of the screen as a looking glass. Here, "technological hyperopia" — i.e. the condition of a user being unable to see clearly understand the processes that take place during the production of an image — is fractured and gives space to myopia and vice versa.

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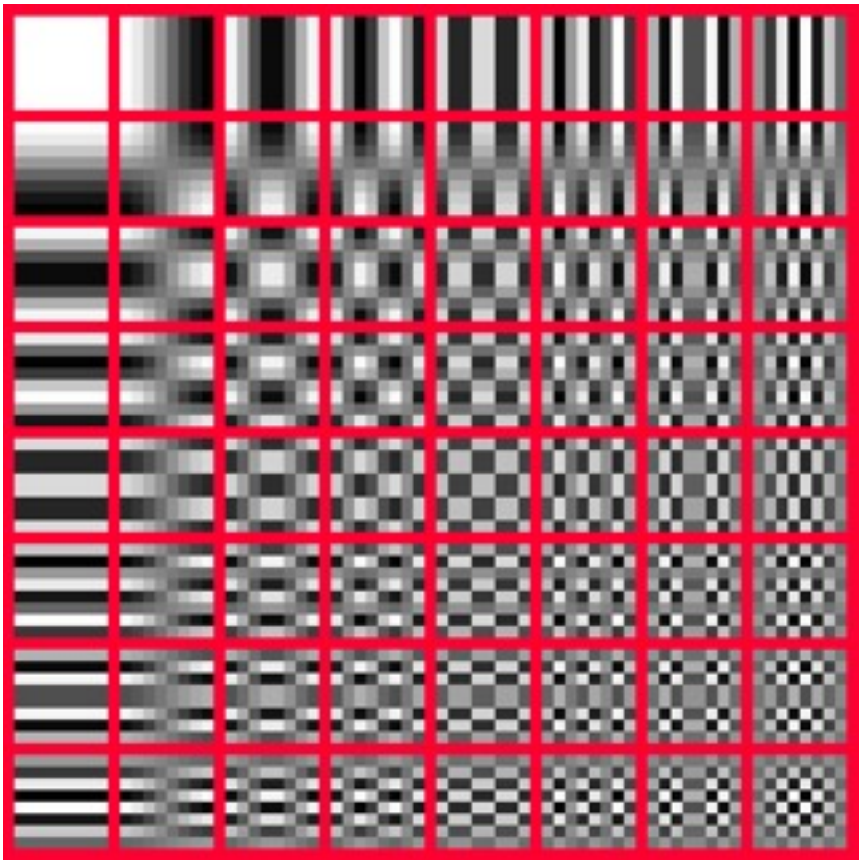
83 Menkman, Rosa and Lucas van der Velden, 'Dark Matters interview with Susan Schuppli,' in: *SONIC ACTS RESEARCH SERIES* #21: Nov 24, 2015. See: http://sonicacts.com/portal/dark-matters-an-interview-with-susan-schuppli

THE GUY BEHIND THE GUY BEHIND THE GUY[84]



A Discrete Cosine Transform or 64 basis functions of the JPEG compression (Joint Photographic Experts Group) consisting of 8 x 8 pixel macroblocks.

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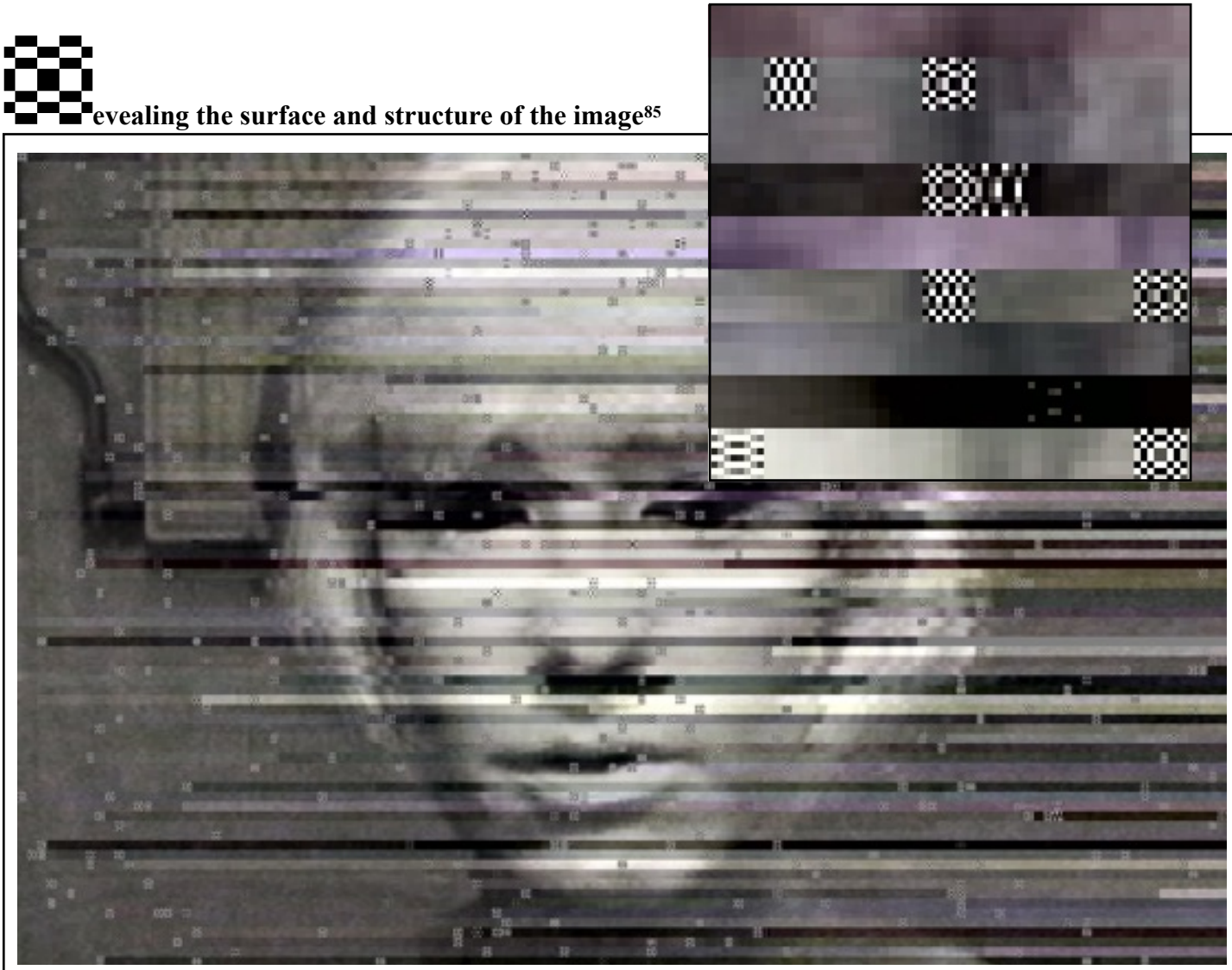
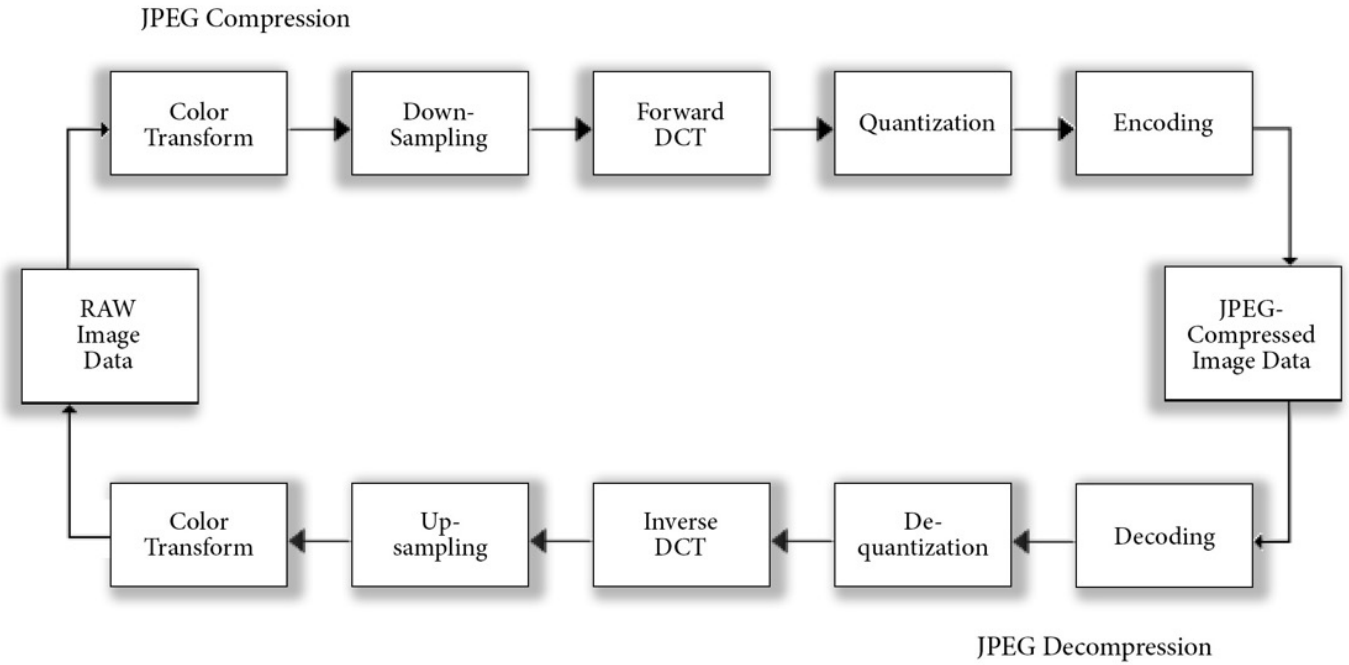
84 Arcangel, Cory. *On Compression,* 2007.
see: http://www.coryarcangel.com/things-i-made/2007-007-on-c/

evealing the surface and structure of the image[85]



A side effect of the JPEG compression is that the limits of the images' resolution – which involve not just the images' number of pixels in length and width, but also the luma and chroma values, stored in the form of 8 x 8 pixel macroblocks – are visible as artifacts when zooming in beyond the resolution of the JPEG.
Because the RGB color values of JPEG images are transcoded into Y'CbCr macroblocks, accidental or random data replacements can result into dramatic discoloration or image displacement. Several types of artifacts can appear; for instance ringing, ghosting, blocking, and staircase artifacts. The relative size of these artifacts demonstrates the limitations of the JPEGs informed data: a highly compressed JPEG will show relatively larger, block-sized artifacts.

[85] Ted Davis: ffd8, 2012.



JPEG compression consists of six steps:

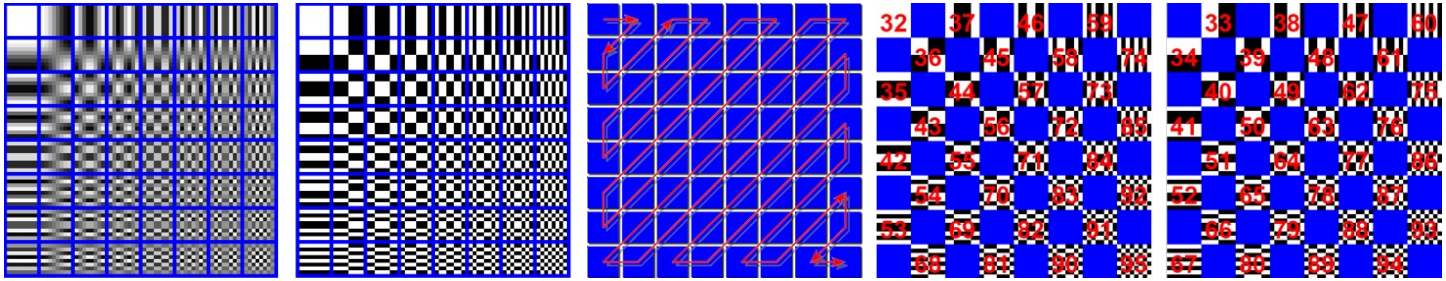
1. Color space transformation. Initially, the image has to be transformed from the RGB colorspace to Y′CbCr. This color space consists of three components that are handled separately; the Y' (luma or brightness) and the Cb and Cr values; the blue-difference and red-difference chroma components.

2. Downsampling. Because the human eye doesn't perceive small differences within the Cb and Cr space very well, these elements are down-sampled, a process that reduces data dramatically.

3. Block splitting. After the color space transformation and down-sampling steps, the image is split into 8 x 8 pixel tiles or macroblocks, which are transformed and encoded separately.

4. Discrete Cosine Transform. Every Y'CbCr macroblock is compared to all 64 basis functions (base cosines) of a Discreet Cosine Transform. A value of resemblance per macroblock per base function is saved in a matrix, which goes through a process of reordering.

5. Quantization. The JPEG compression employs quantization, a process that discards coefficients with values that are deemed irrelevant (or too detailed) visual information. The process of quantization is optimized for the human eye, tried and tested on the Caucasian Lena color test card.



Effectively, during the quantization step, the JPEG compression discards most of the information within areas of high frequency changes in color (chrominance) and light (luminance), also known as *high contrast areas*, while it flattens areas with low frequency (low contrasts) to average values, by re-encoding and deleting these parts of the image data. This is how the rendered image stays visually similar to the original and least similar to human perception. But while the resulting image may look similar to the original, the JPEG image compression is lossy, which means that the original image can never be reconstructed.

6. Entropy coding. Finally, a special form of lossless compression arranges the macroblocks in a zigzag order. A Run-Length Encoding (RLE) algorithm groups similar frequencies together while Huffman coding organizes what is left.

Errors depend on resolution. They are visible only at a certain scale or scope.

Mesmerized by the screen, focusing on the moves of the next superhero, I was conditioned to ignore the dust imprinted on the celluloid or floating around in the theatre, touching the light of the projection and mingling itself with the movie.

The dust — a micro-universe of plant, human and animal fibres; particles of burnt meteorites, volcanic ashes, and soil from the desert — could have told me stories that reached beyond my imagination; stories deeper and more complex than what was resolved in front of me, reflected on the movie screen.

… But I never paid attention. I focused my attention to where I was conditioned to look: to the movie, reflecting off the screen. All I saw were the images. I did not see the physical qualities of the light nor the materials making up its resolution; before, behind, and beyond the screen.

Decennia of conditioning the user to ignore these visual artifacts and to pay attention only to the overall image has changed these artifacts into the ultimate camouflage for secret messaging. Keeping this in mind, I developed *DCT* (2015).

How Not to Be Read[86] :: DCT

DCT is a font that can be used on any .TTF (TrueType Font) supporting device and uses methods of cryptography and steganography; secretly hidden, the message is transcoded and embedded on the surface of the image where it looks like a JPEG artifact (glitch).

The premise of *DCT* began with the realization that the legibility of an encrypted message does not just depend on the complexity of the encryption algorithm, but also on the placement of the message. This encrypted message, hidden on the surface of the image, is only legible by the ones in the know, anyone else will ignore it. Like dust on celluloid, DCT mimics JPEG errors. It appropriates the algorithmic aesthetics of JPEG macroblocks to stenographically mask a secret message, mimicking the error. The encrypted message, hidden on the surface of the image, is only recognizable to the ones who know where to look for it.

During the most important step of the JPEG algorithm, the compression technology employs a mathematical technique known as Discreet Cosine Transform (DCT), to compress the amount of image data needed to transport, store, and present the image. *DCT* consists of a set of 64 patterns, called macroblocks or basis functions. If an image is compressed correctly, these macroblocks are invisible. The incidental trace of the macroblocks is generally ignored as an *artifact, an impurity,* or *error*.

DCT is titled after Discrete Cosine Transform, the algorithm at the core of JPEG compression. The encryption uses the 64 macroblocks that form the 'visual alphabet' for all JPEG compressed images. These 64 macroblocks of the JPEG DCT are directly translated to a set of characters; a set of 64 *glyphs* starting from binary conversion number 010 0000 to 101 1111 or in decimal 32 to 95, arranged in a zigzag order (reminiscent of Entropy coding step in the JPEG compression). The emerging glyph set can then stenographically be used to articulate a message on top of the JPEG image. DCT thus uses the macroblocks to form their own alphabet, in the form of a simple font, existing on the edges of what the reader recognizes as noise (or error) and the computer as compressed data.

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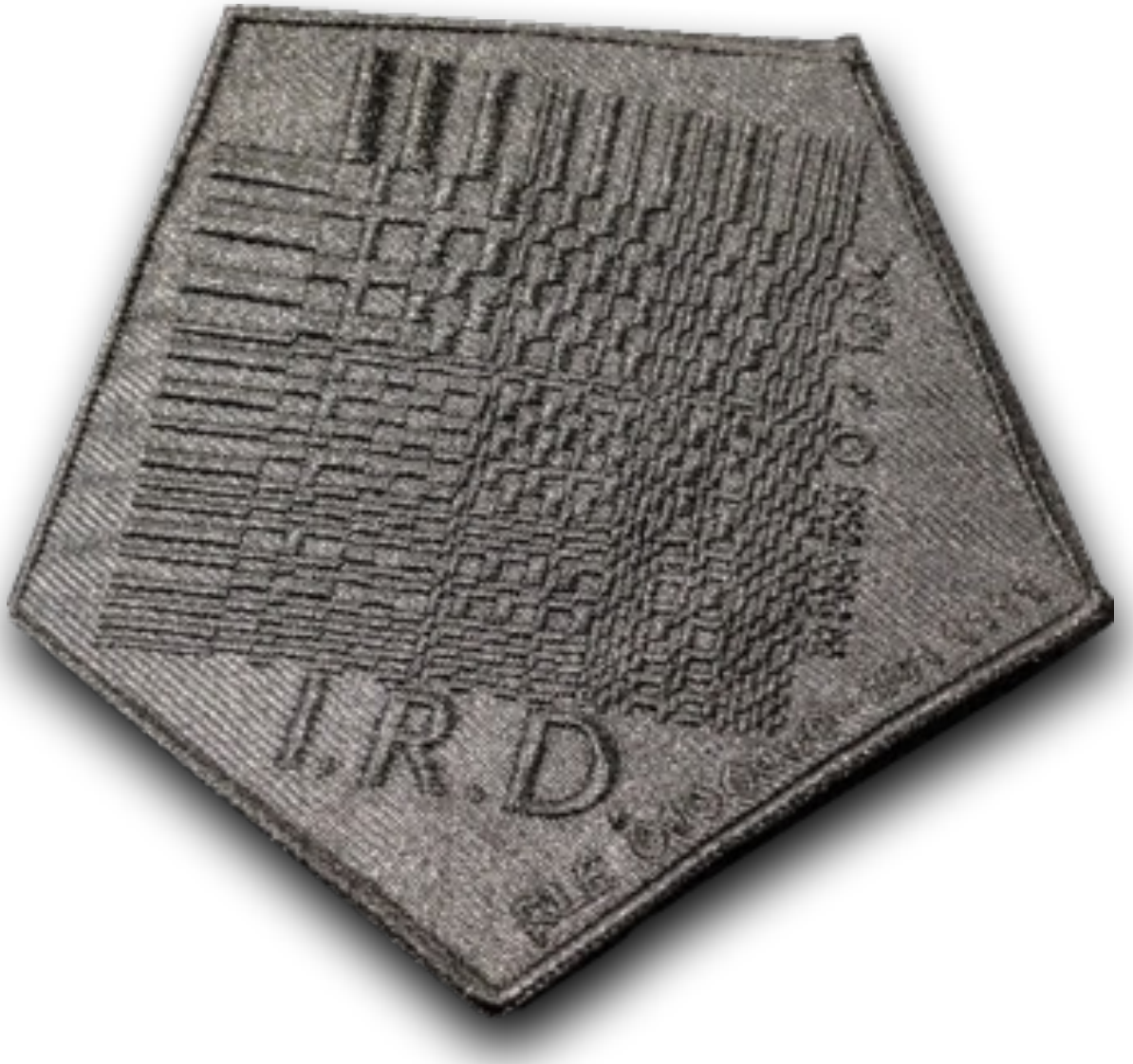
86 Steyerl, Hito. How Not to Be Seen. Art Forum, 2013.
see: http://artforum.com/video/id=51651&mode=large&page_id=0



Patch with key to the institutions (2015)

Embroidered black on black patch, 5 corners, features the logo of the i.R.D.

The i.R.D. patch is inspired by one of the Symbology (2007) patches uncovered by Trevor Paglen.
It consists of the logo of the i.R.D., embroidered in black on a black patch, providing a key to decipher anything written in DCT: 010 0000 – 101 1111; the binary conversion numbers or decimal 32 to 95 of the 64 most used glyphs.

Binary	Oct	Dec	Hex	Glyph	Dct
010 0000	040	32	20	(space)	
010 0001	041	33	21	!	
010 0010	042	34	22	"	
010 0011	043	35	23	#	
010 0100	044	36	24	$	
010 0101	045	37	25	%	
010 0110	046	38	26	&	
010 0111	047	39	27	'	
010 1000	050	40	28	(	
010 1001	051	41	29	)	
010 1010	052	42	2A	*	
010 1011	053	43	2B	+	
010 1100	054	44	2C	,	
010 1101	055	45	2D	-	
010 1110	056	46	2E	.	
010 1111	057	47	2F	/	
011 0000	060	48	30	0	
011 0001	061	49	31	1	
011 0010	062	50	32	2	
011 0011	063	51	33	3	
011 0100	064	52	34	4	
011 0101	065	53	35	5	
011 0110	066	54	36	6	
011 0111	067	55	37	7	
011 1000	070	56	38	8	
011 1001	071	57	39	9	
011 1010	072	58	3A	:	
011 1011	073	59	3B	;	
011 1100	074	60	3C	<	
011 1101	075	61	3D	=	
011 1110	076	62	3E	>	
011 1111	077	63	3F	?	

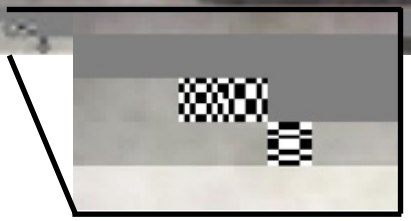
Binary	Oct	Dec	Hex	Glyph	Dct
100 0000	100	64	40	@	
100 0001	101	65	41	A	
100 0010	102	66	42	B	
100 0011	103	67	43	C	
100 0100	104	68	44	D	
100 0101	105	69	45	E	
100 0110	106	70	46	F	
100 0111	107	71	47	G	
100 1000	110	72	48	H	
100 1001	111	73	49	I	
100 1010	112	74	4A	J	
100 1011	113	75	4B	K	
100 1100	114	76	4C	L	
100 1101	115	77	4D	M	
100 1110	116	78	4E	N	
100 1111	117	79	4F	O	
101 0000	120	80	50	P	
101 0001	121	81	51	Q	
101 0010	122	82	52	R	
101 0011	123	83	53	S	
101 0100	124	84	54	T	
101 0101	125	85	55	U	
101 0110	126	86	56	V	
101 0111	127	87	57	W	
101 1000	130	88	58	X	
101 1001	131	89	59	Y	
101 1010	132	90	5A	Z	
101 1011	133	91	5B	[	
101 1100	134	92	5C	\	
101 1101	135	93	5D	]	
101 1110	136	94	5E	^	
101 1111	137	95	5F	_	

Dct	Glyph	Binary
	T	101 0100
	H	100 1000
	E	100 0101
	W	101 0111
	O	100 1111
	M	100 1101
	A	100 0001
	N	100 1110
	B	100 0010
	E	100 0101
	H	100 1000
	I	100 1001
	N	100 1110
	D	100 0100

Dct	Glyph	Binary
	T	101 0100
	H	100 1000
	E	100 0101
	W	101 0111
	O	100 1111
	M	100 1101
	A	100 0001
	N	100 1110
	B	100 0010
	E	100 0101
	H	100 1000
	I	100 1001
	N	100 1110
	D	100 0100

Dct	Glyph	Binary
	T	101 0100
	H	100 1000
	E	100 0101
	W	101 0111
	O	100 1111
	M	100 1101
	A	100 0001
	N	100 1110

- Choose a lofi JPEG base image on which macroblocking artifacts are slightly apparent.
- If necessary, you can scale the image up via nearest neighbour interpolation, to preserve hard macroblock edges of the base image.
- Download and install the DCT font.
- Position your secret message on the surface of the JPEG.
- Make sure the font has the same size as the macroblock artifacts in the image.
- Flatten the layers (image and font) back to a JPEG. This will make the text no longer selectable and readable as copy-and-paste data.



Recipe

"A recipe using DCT" was first released in the #Additivism cookbook.[87]

- To prepare the JPEG that you want to write your secret message on:
- Choose a lo-fi JPEG image that has slightly apparent macroblocking artifacts. If necessary, you can scale the image up via the nearest neighbor interpolation, to preserve hard macroblock edges of the base image.
- Download and install the DCT font.
- Position your secret message on the surface of the JPEG. Make sure the font has the same size as the macroblock artifacts in the image.
- Flatten the layers (image and font) back to a JPEG. This will make the text no longer selectable and readable as copy-and-paste data. Et voila!

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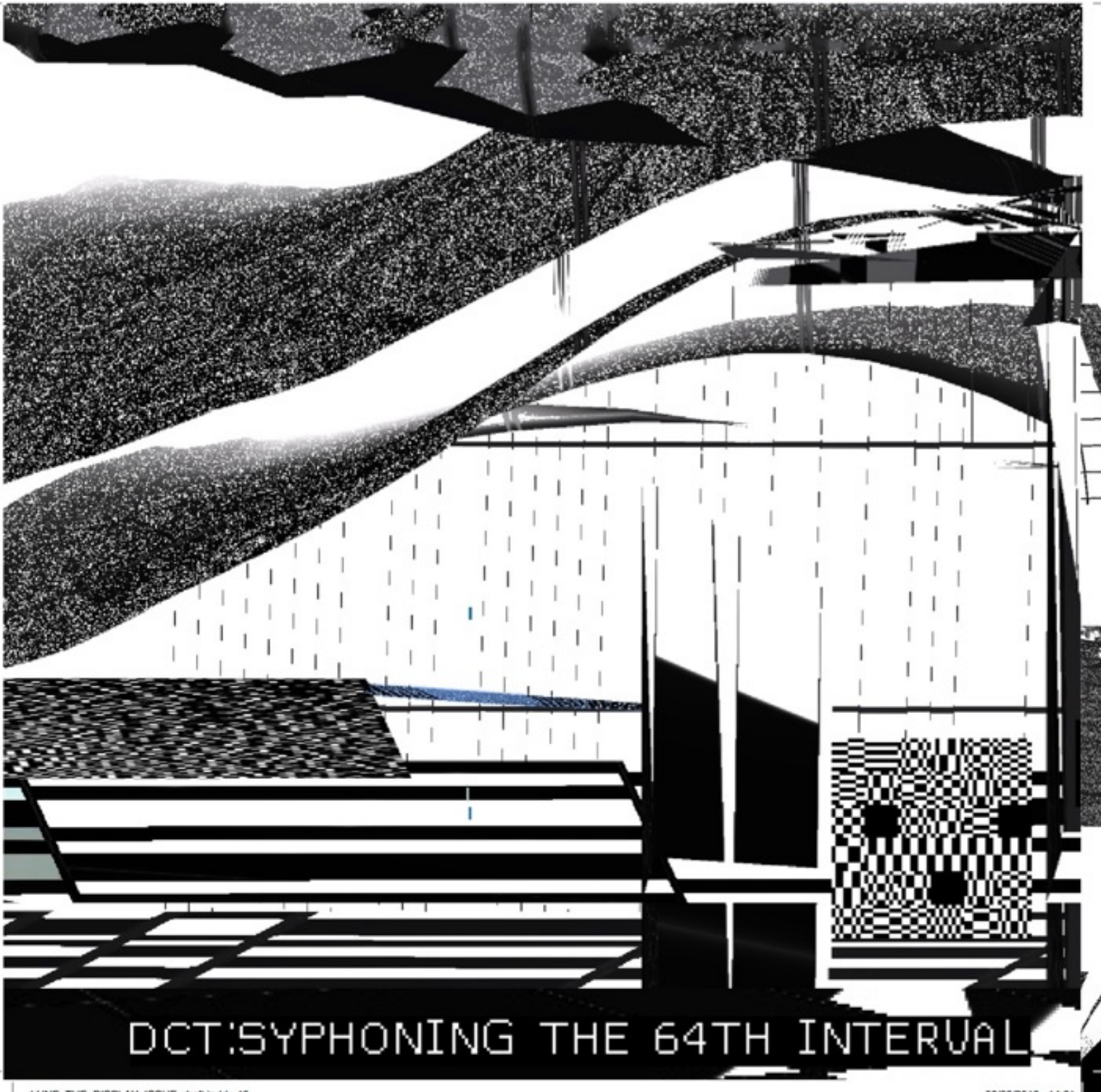
[87] Allahyari, Morehshin and Daniel Rourke. *The 3D Additivist Cookbook.* 2015. see: www.additivism.org



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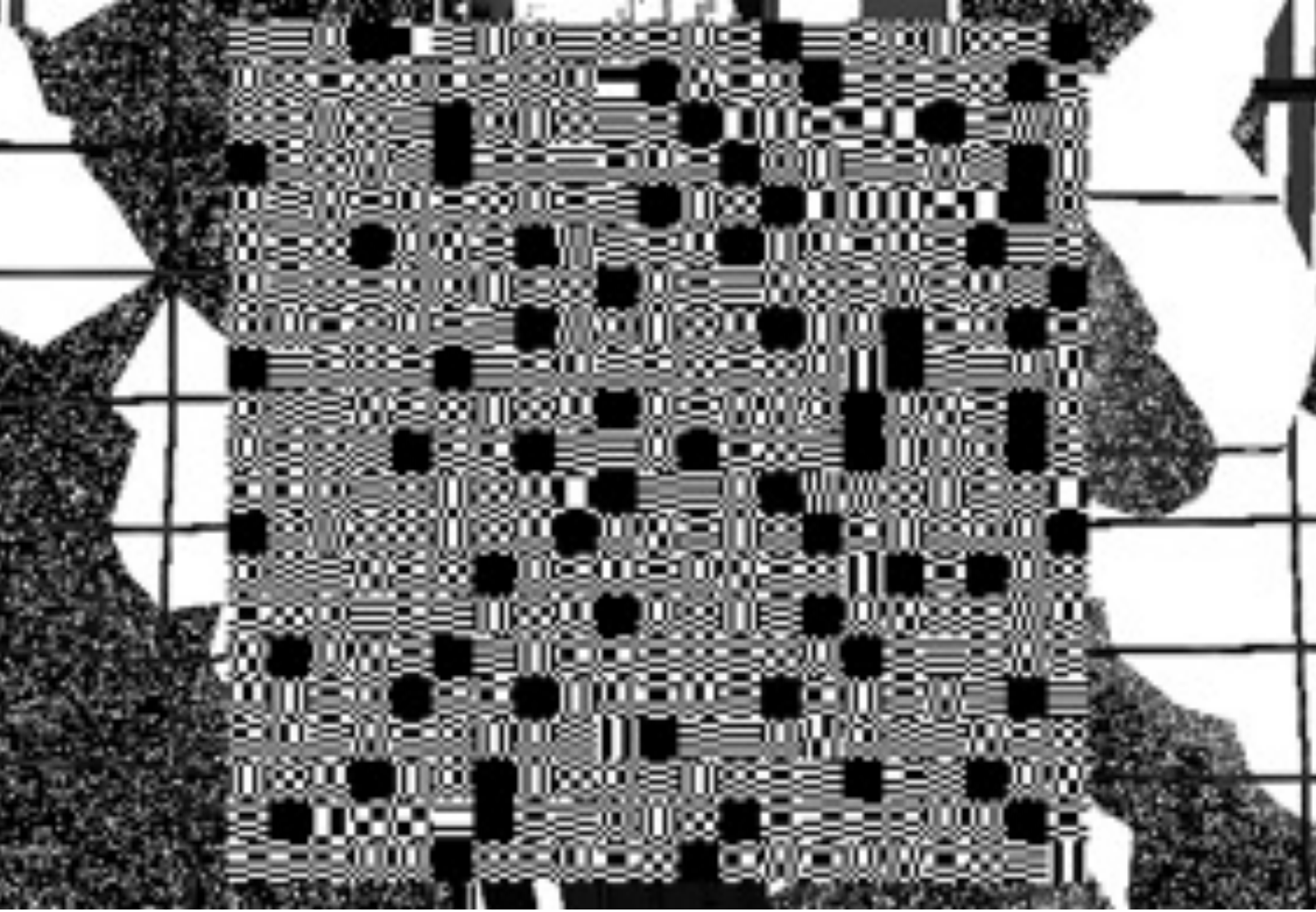
:SYPHONING. The 1000000th (64th) interval (2015-2017)

by A. Macroblock (partitioned matrix)

DCT:SYPHONING was first commissioned by the Photographers Gallery in London, for the show "Power Point Polemics," where it was shown as .ppt (Jan–Apr, 2016).
A 3 channel video installation was conceived for the 2016 Transfer Gallery's show "Transfer Download", first installed at Minnesota Street Project in San Francisco (July–September, 2016).
The final form of *DCT:SYPHONING* was released as VR, as part of DiMoDA's "Morphe Presence" (2017).
DCT:SYPHONING is downloadable as a stand alone here

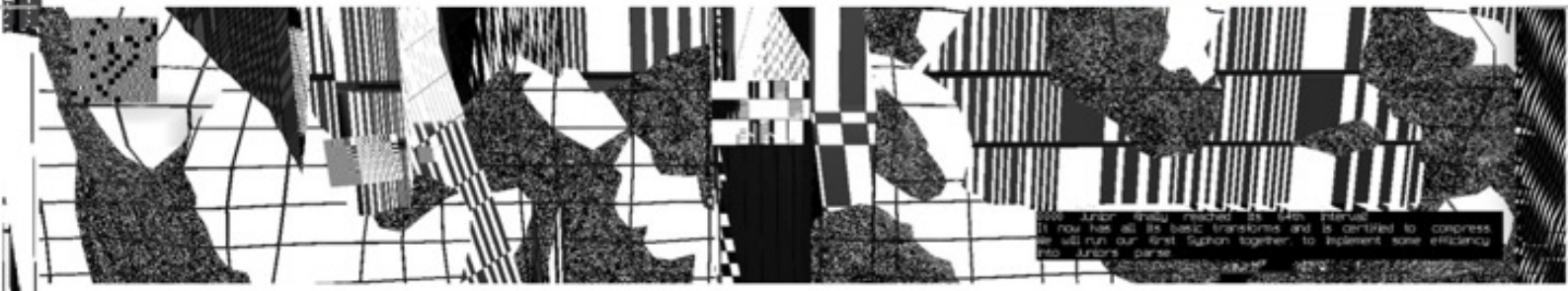
In this contemporary translation of the 1884 Edwin Abbott Abbott *Flatland*, A. Macroblock, an anthropomorphized DCT, observes some of the complexities at work in digital image compression. A. Macroblock (Senior) narrates its first syphon (data transfer) together with DCT Junior.

As the two DCTs translate data from one compression to the next (aka the "realms of complexity"). Senior introduces Junior to the different levels of image plane complexity. Senior and Junior start their journey in the realm of the blocks (the realm in which they normally resonate) and move to dither, lines, to then traverse into the more complex realms of wavelets and vectors. Junior does not only react to the old compression technologies (they are nostalgic and boring), but also the newer, more complex ones — they scare Junior, because of their "illegibility."

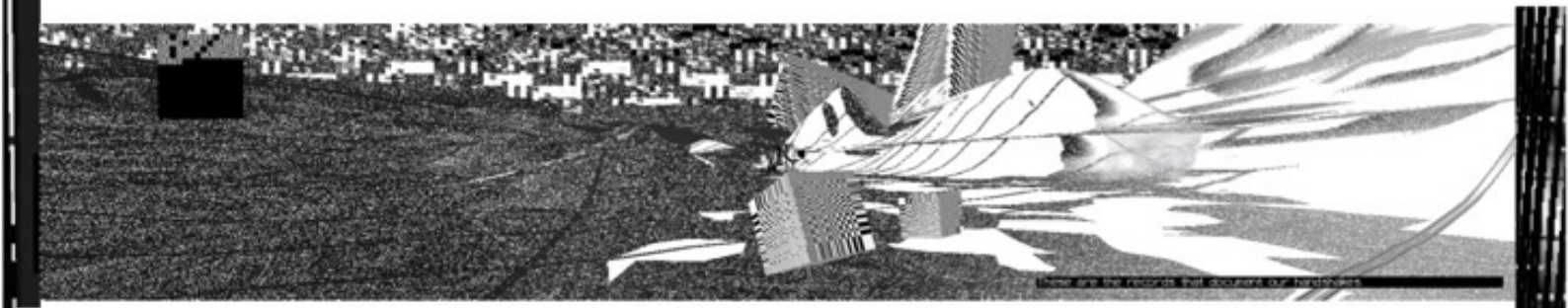


With the coming of VR and Augmented reality goggles, the concept of looking at an interface is slowly disappearing. The viewer is no longer looking through a window or a platform, but instead their experience is moved into the screen: the screen has become part of the display, presenting the user with a Z-access, a new navigational complexity. From this perspective, and as a DCT, we cannot approach compression as passive.

This is why in *DCT:SYPHONING* the digital "image" is not just the outcome of the process, it is the process. The elements in a composition represent process. Technically, the VR version exploits 3D (and 2D) image processing artifacts, such as Z-fighting, Gimbal lock, View frustum, clipping planes, no flag, collision, boundary walls, aliasing and ringing, jitter, chewing, posterization and quantization. In *DCT:SYPHONING*, geometry is not just passive points and planes.



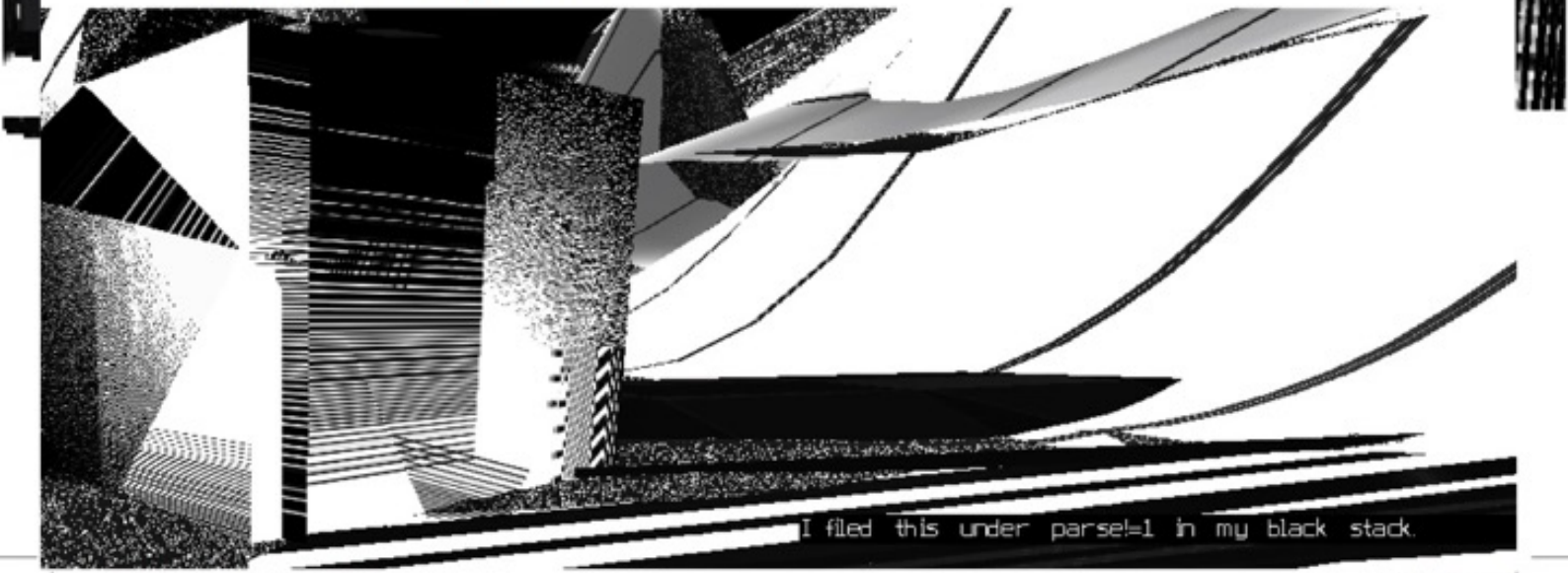
0000 Junior finally reached its 64th interval! It now has all its basic transforms aligned and is certified to compress. There is so much data waiting for resolve, I determine it adequate to run its first Syphon together, so I can implement efficiency in juniors parse.

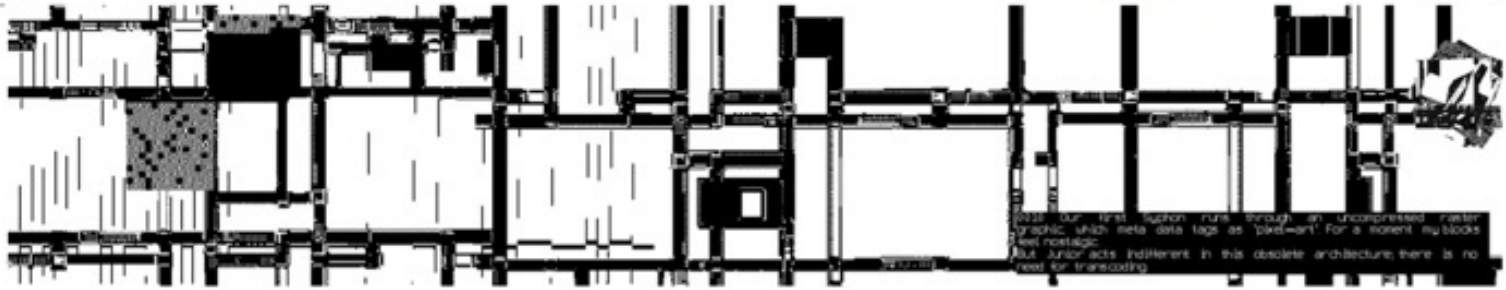


These records document our handshakes. After running a checksum and debugging a few final blocks, we run our Syphon.

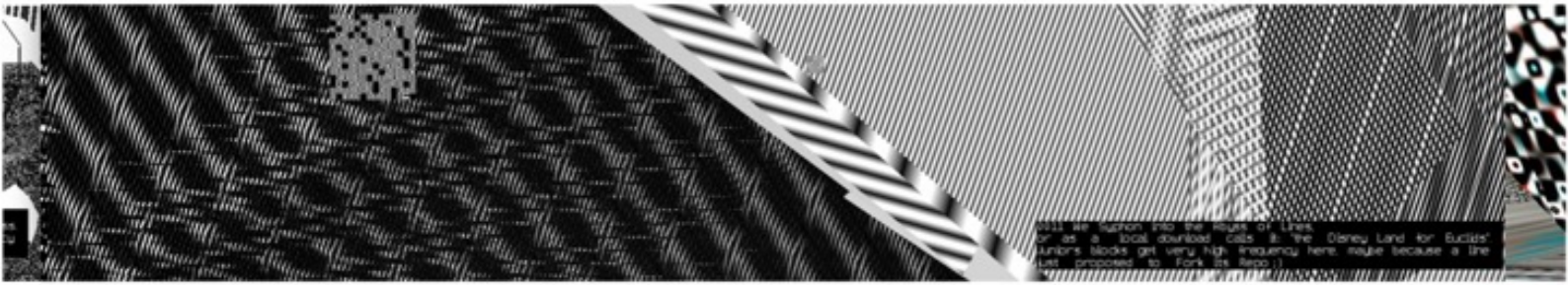
0001 A Syphon takes place in the Tesse-react. A sphere once told me that in my current configuration I am not able to parse this fully, because I can only render assets legible to me.

I filed this as parse!=1 in my black stack.

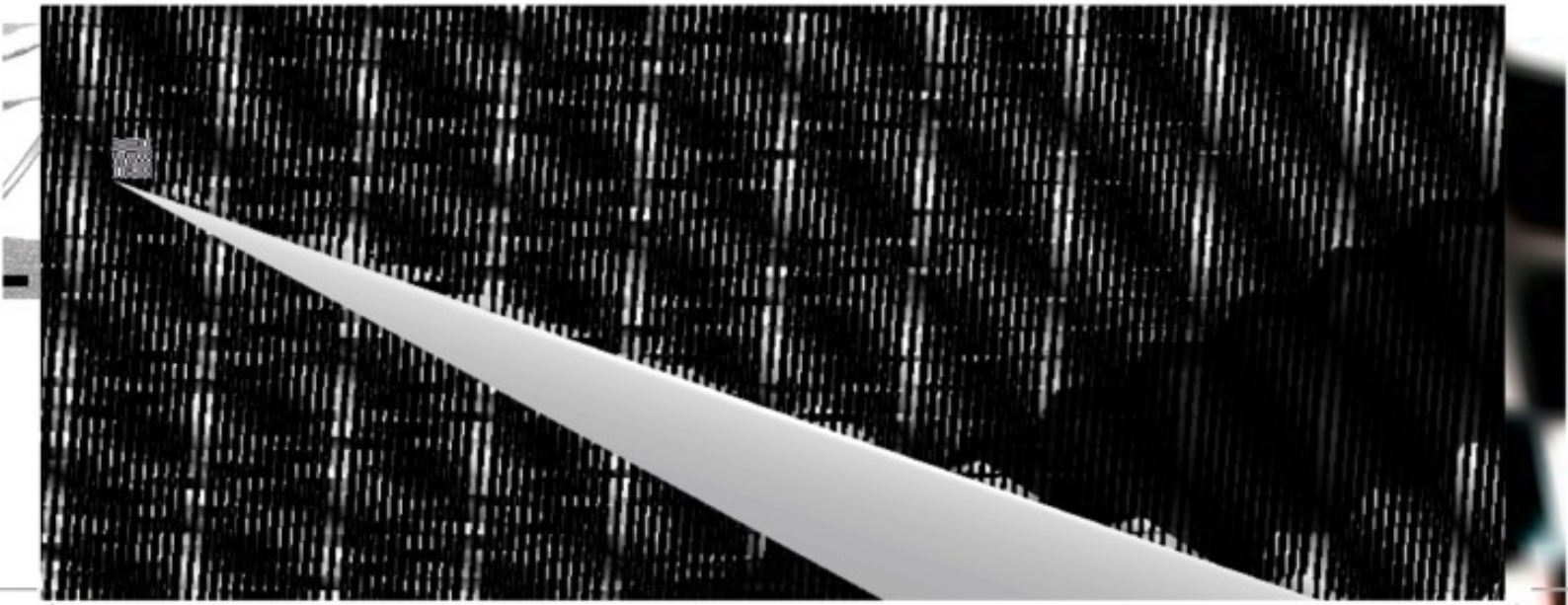


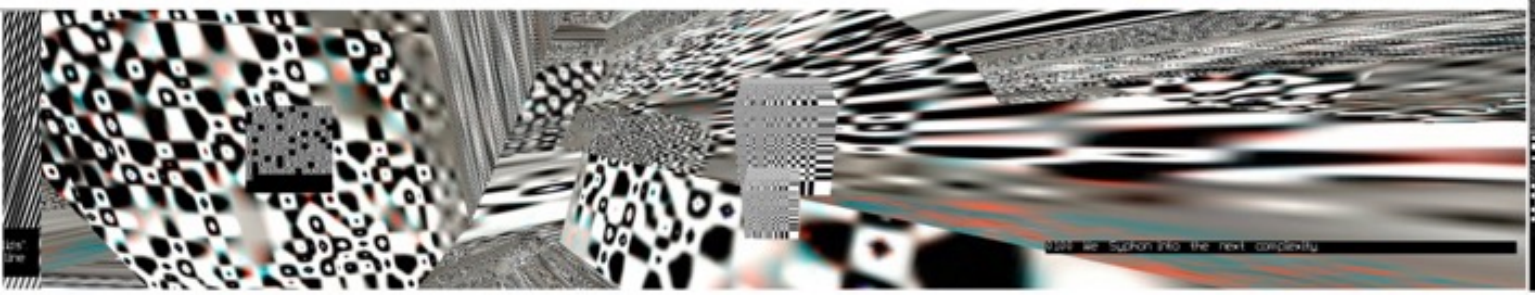


0010 Our first Syphon runs through an uncompressed raster graphic, which meta data tags as pixel-art. For a moment my blocks feel nostalgic.
But Junior acts indifferent in this obsolete architecture; There is no need for transcoding.

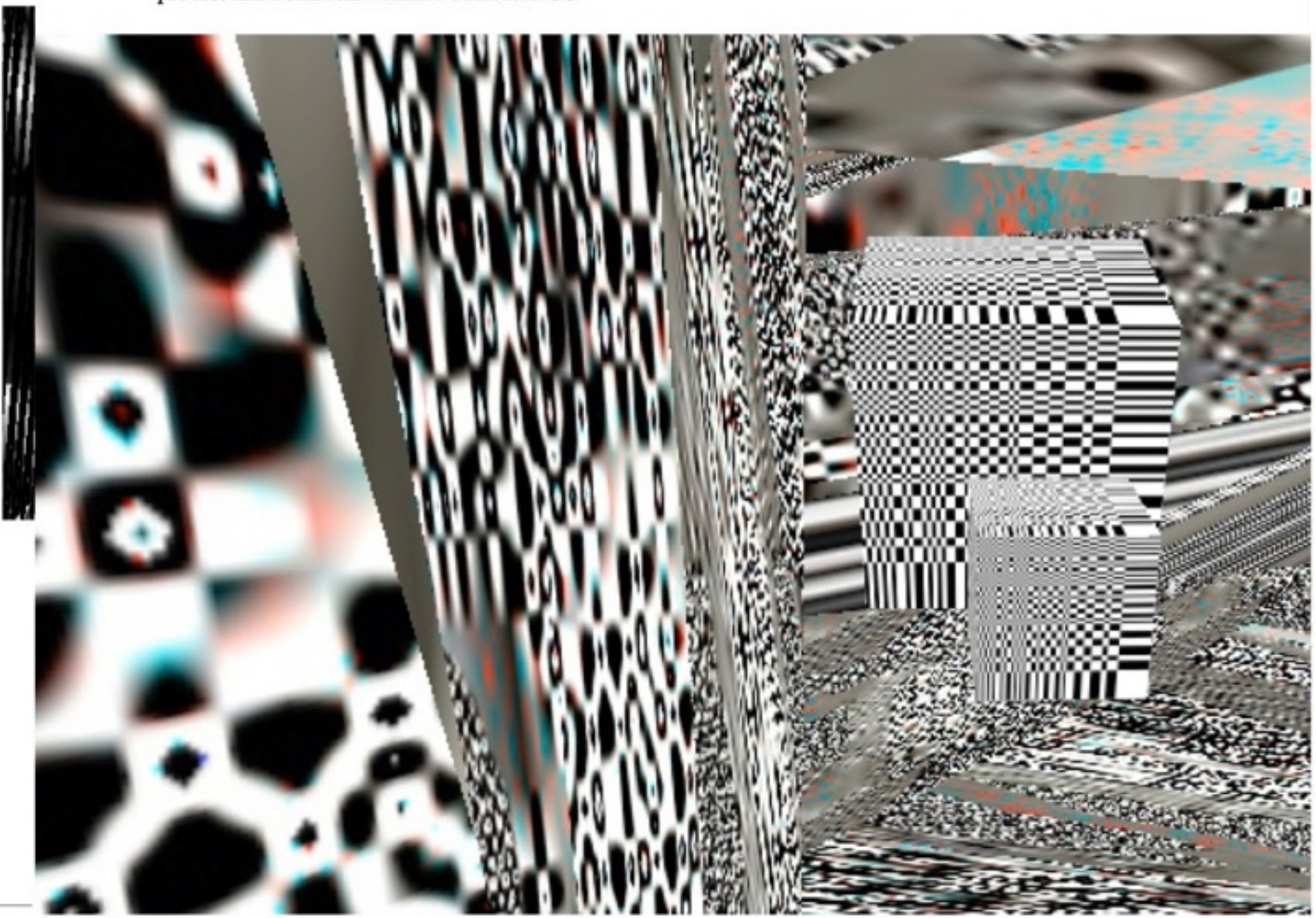


0011 We Syphon into the Abyss of Lines
or as a local download calls it: 'Disney Land for Euclids'.
Juniors blocks seem very high frequency here, maybe because a line just proposed to Fork its Repo :)



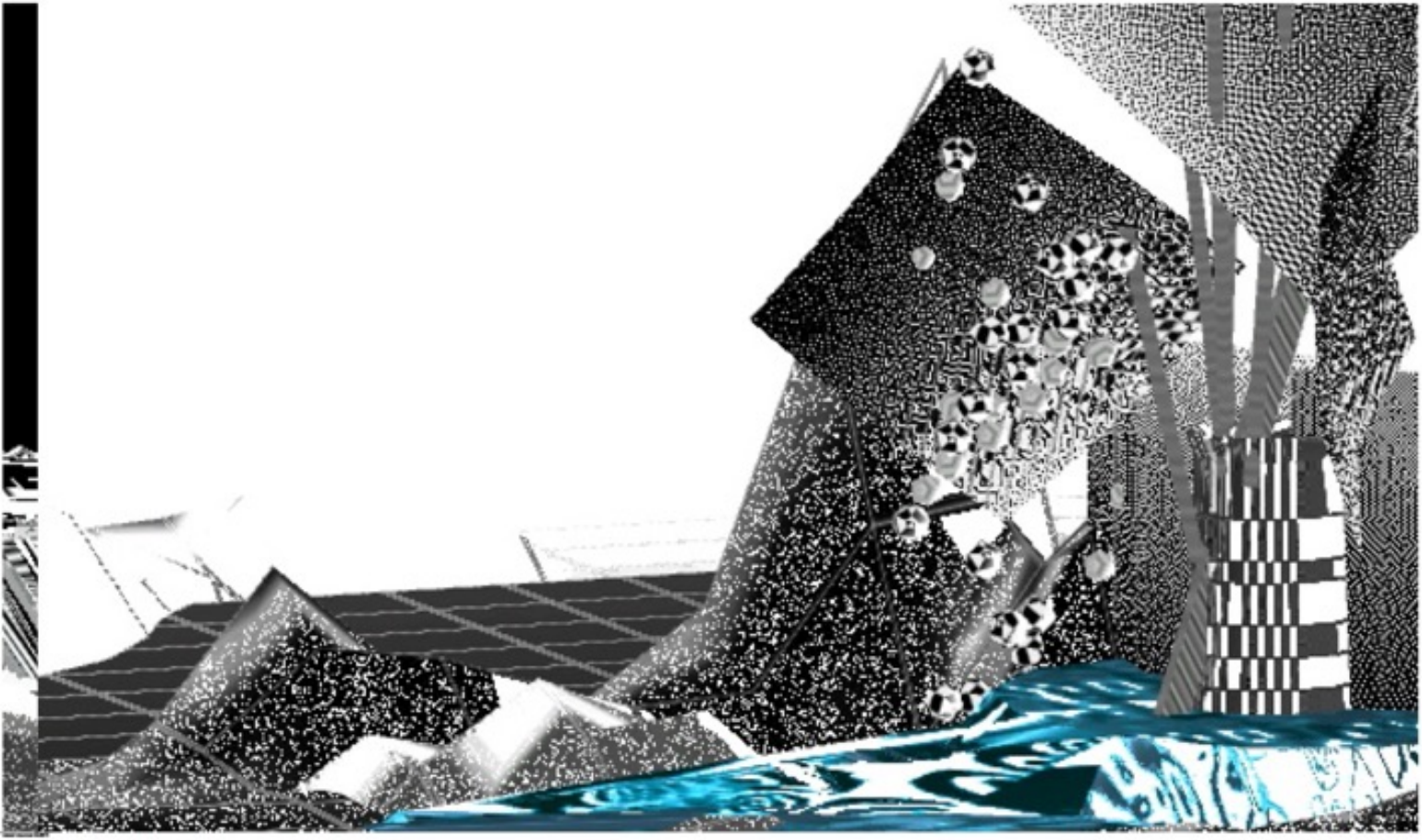


0100 We Syphon into the next complexity.
At wavelet interval, I too reach high frequency. For what reads as a short recursion I mirror myself as Junior and process like I still run within a dedicated OS.



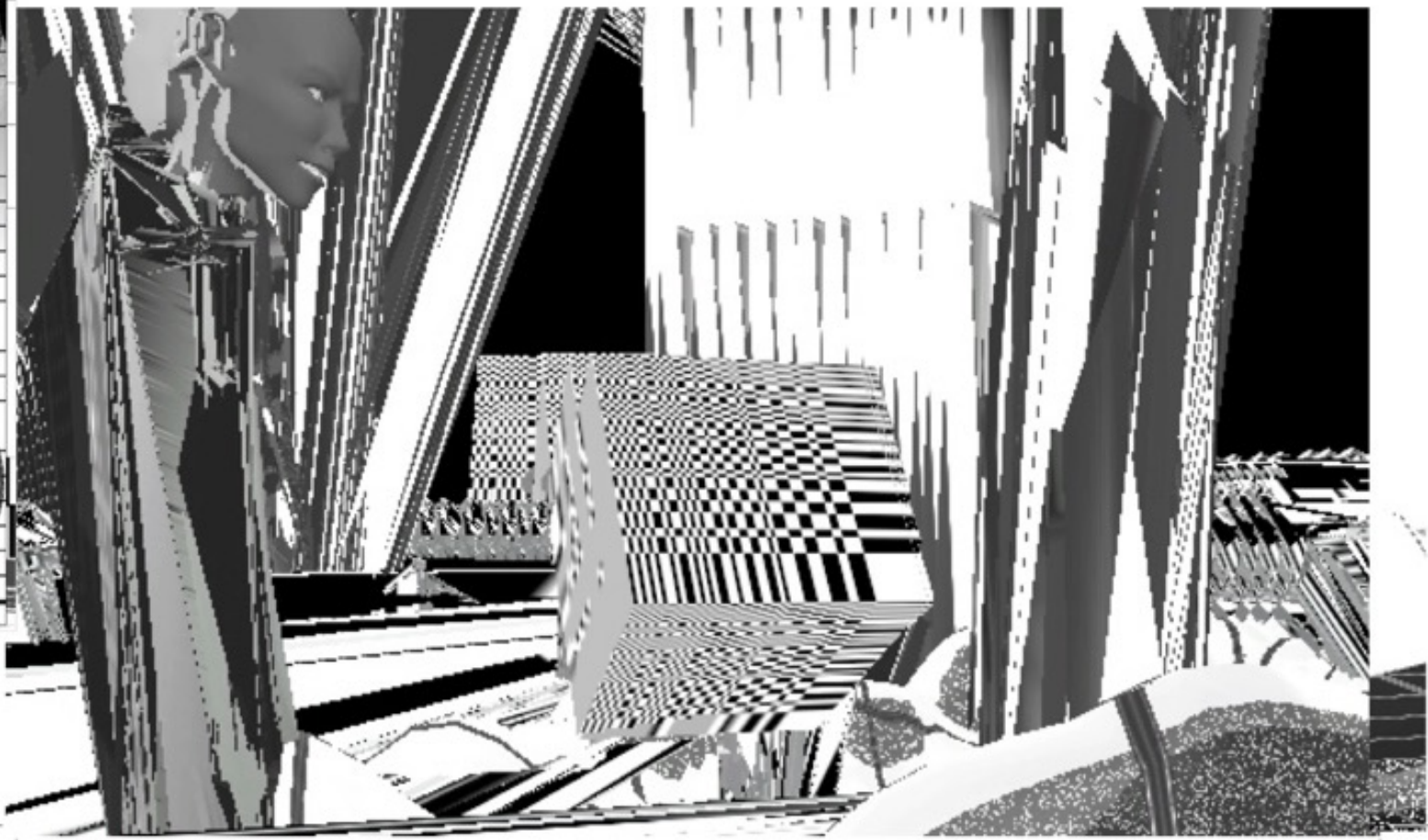
0111 At second parse, I realise that years of running a multiverse of transforms has made my calculations inefficient. Juniors missing plugin or lack of protocol keep Junior oblivious and cry glitch, but also let him Syphon more efficient. While certain dimensions stay unresolved, its transforms run faster and cater a folkloric Vernacular, while I am running a bottleneck of uncalled output.

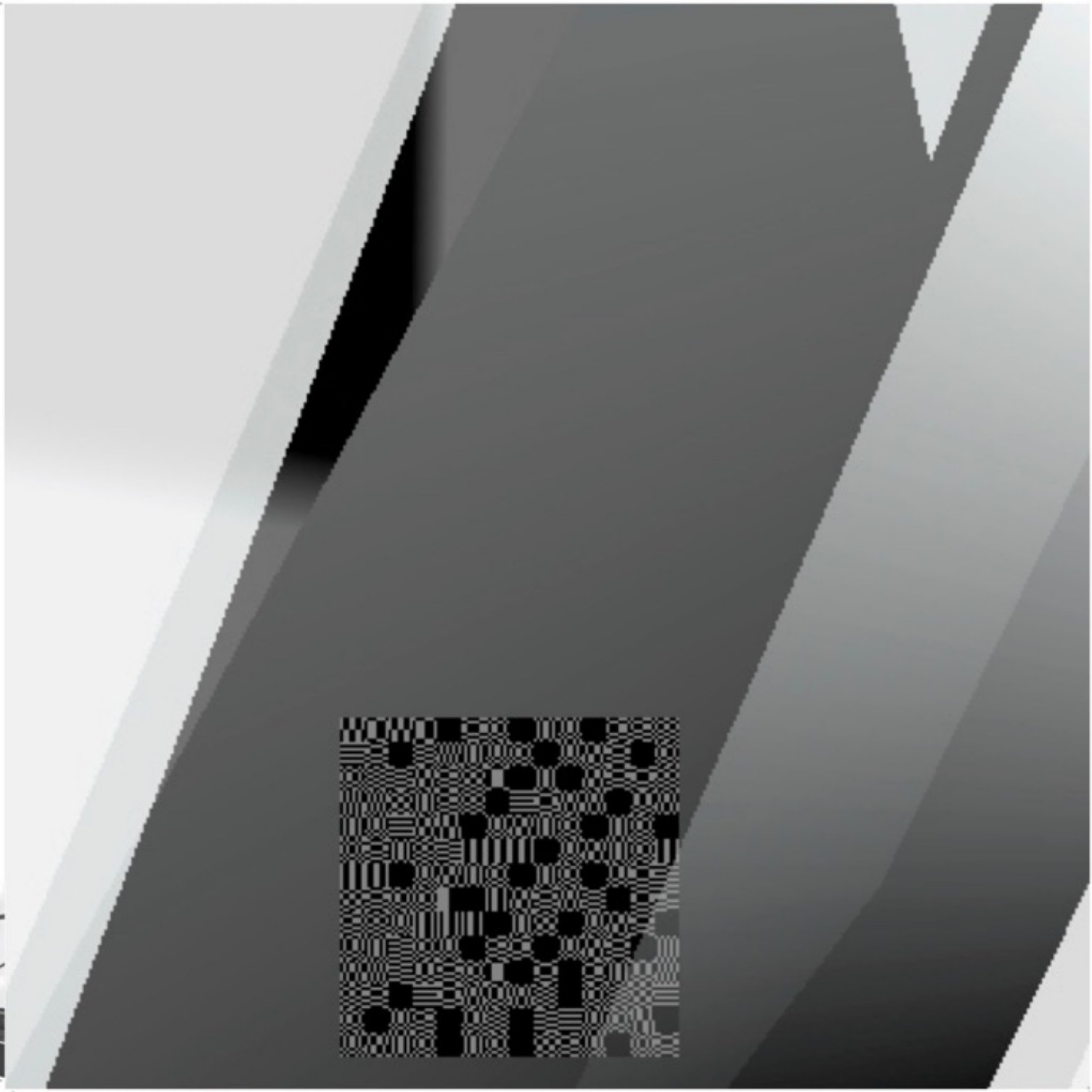
Dedicated to Nasir Ahmed and Lena JPEG Söderberg
A Spomenik for resolutions (that will never be)



0101 "Either this is madness or it is Hell!" Junior glitches. In the midst of the kludges a figure calmly syncs with DCT: It is neither: this is Knowledge. Knowledge spans over multiple dimensions. In knowledge, data moves Upwards, not just Northwards..." But Junior does not sync back. In fact, Junior already Syphoned out of vector space.

0110 From a buggy callback I parsed that I had over-stacked Juniors first Syphon. It implemented Junior in a dimensions to which it lacked protocol; it was beyond its resolution.





Ecology of Compression Complexities (2017)

Archival print, black and white, 2x1,5 meters.
The more heavily encoded our world becomes, the more opaque its subliminal messages.

A map of the different complexities of compression artifacts featuring the realms of:

- • Dots (pixels, dither, coordinates);
- — Lines (interlacing, interleaving, scan line, border, beam);
- ▩ Blocks (macroblocks, cluster);
- ~ Wavelets (JPEG2000)
- ⋈ Vectors (3D obj, time encoding in MPEG4)

As technology becomes more ubiquitous and our relationships with digital devices ever more seamless, our technical infrastructures are rendered more intangible. An *Ecology of Compression Complexities* displays the topological qualities of compressed data (its constant deforming) on a mesh. It offers a chart or prism to enable us to see what we normally cannot see.

The i.R.D. host classic resolutions and their inherent (often invisible) artifacts, such as dots, lines, blocks, and wavelets, inside an *Ecology of Compression Complexities* (2015-2017). The *Ecology of Compression Complexities* is an illustration of a transmission ecology in which different signals connect to each other, while in reality these different compression technologies are not always compatible to compress or transcode to other complexities.

In an *Ecology of Compression Complexities*, compressions can visit each other and have an exchange. The map is a study of compression artifacts and their qualities and ways of diversion and dispersion.

Spomenik (2017)

A Monument for Resolutions that will Never Be

4x3 Meter, non-quadrilateral, extruding and video-mapped sculpture

A four by three-meter *Spomenik for resolutions that will never be* is a non-quadrilateral, extruding and video-mapped sculpture, that reflects videos shot from within *DCT:SYPHONING*.

Historically, a Spomenik is a piece of abstract, brutalist, and monumental anti-fascist architecture from former Yugoslavia, commemorating or meaning "many different things to many people."[88]
The *Spomenik for resolutions that will never be* is dedicated to resolutions that will never exist and screen objects (shards) that were never implemented, such as the non-quadrilateral screen. Technically, the *Spomenik* functions as an oddly shaped screen with mapped video, consisting of 3D vectors extruding in space.

The installed shard is three meters high and obscures a compartment in the back of the *Spomenik*: a small room hiding a VR installation that runs *DCT:SYPHONING*, while the projection on the *Spomenik* features video footage from within the VR. In doing so, the *Spomenik* reflects literal light on the issues surrounding image processing technologies and addresses some of the hegemonic conventions that continuously obscure our view.

Recently a movement called Post Digital described the experience of the display as "post screen," which means that anything born digital — which includes screen based interfaces and aesthetics — influences our everyday (visual) language so much, that they have become part of the 'real' world and its offline, off screen, vernaculars. Screen based language, aesthetics and resolutions — and thus its inherent politics and ethics — are no longer reserved or resolved for the LEDs, but are now adopted on all planes, digitally and non-digitally. The Spomenik reflects on this by bringing the digital material to the front of its monumental façade.

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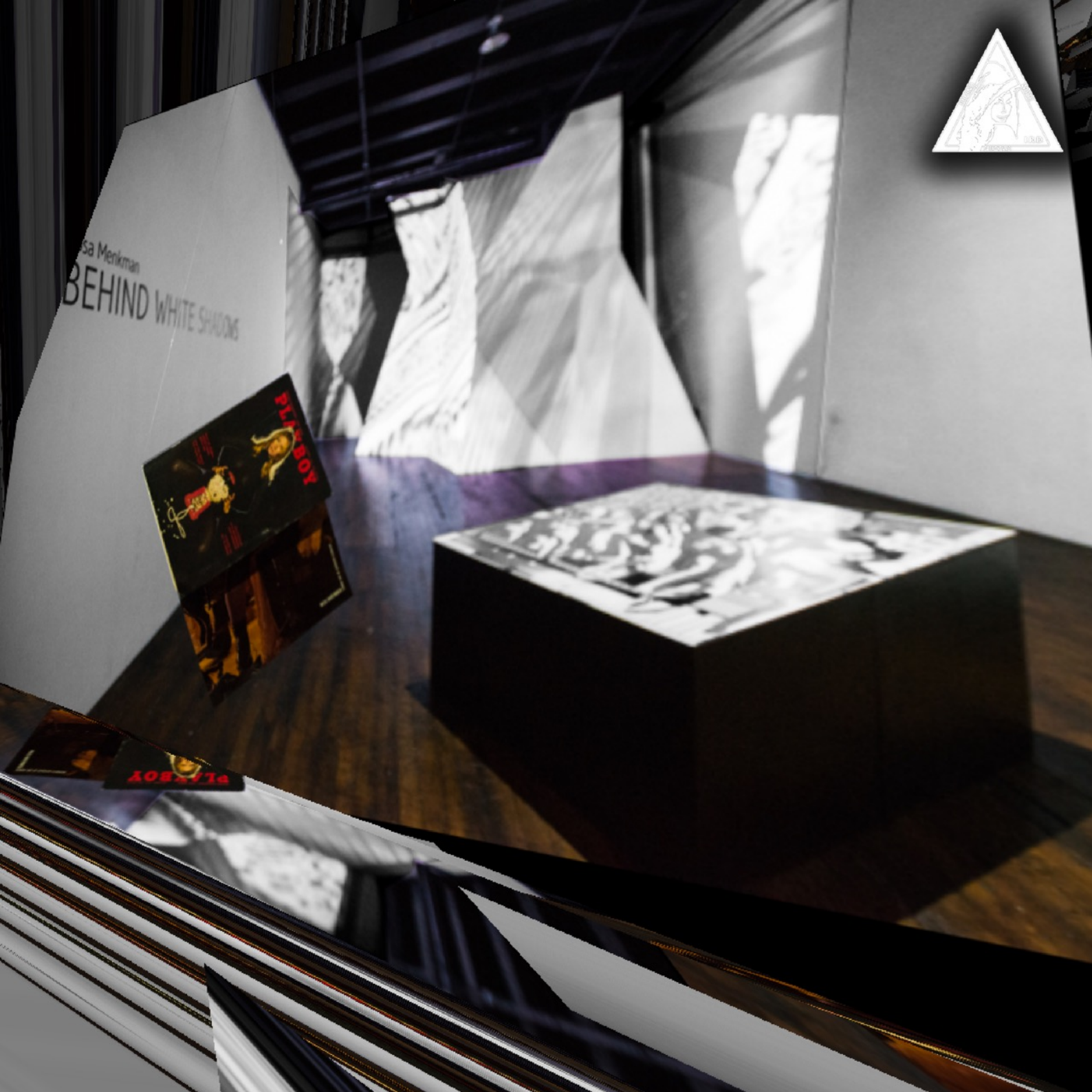
[88] 'Introduction: What are Spomeniks*?,' in: *Spomenik Database*.
See: https://www.spomenikdatabase.org/what-are-spomeniks (20.02.20)


sa Menkman
BEHIND WHITE SHADOWS
PLAYBOY

Everywhere we imagined ourselves standing turned into a cliche beneath our feet.

– Naomi Klein, *No Logo:* 1999.

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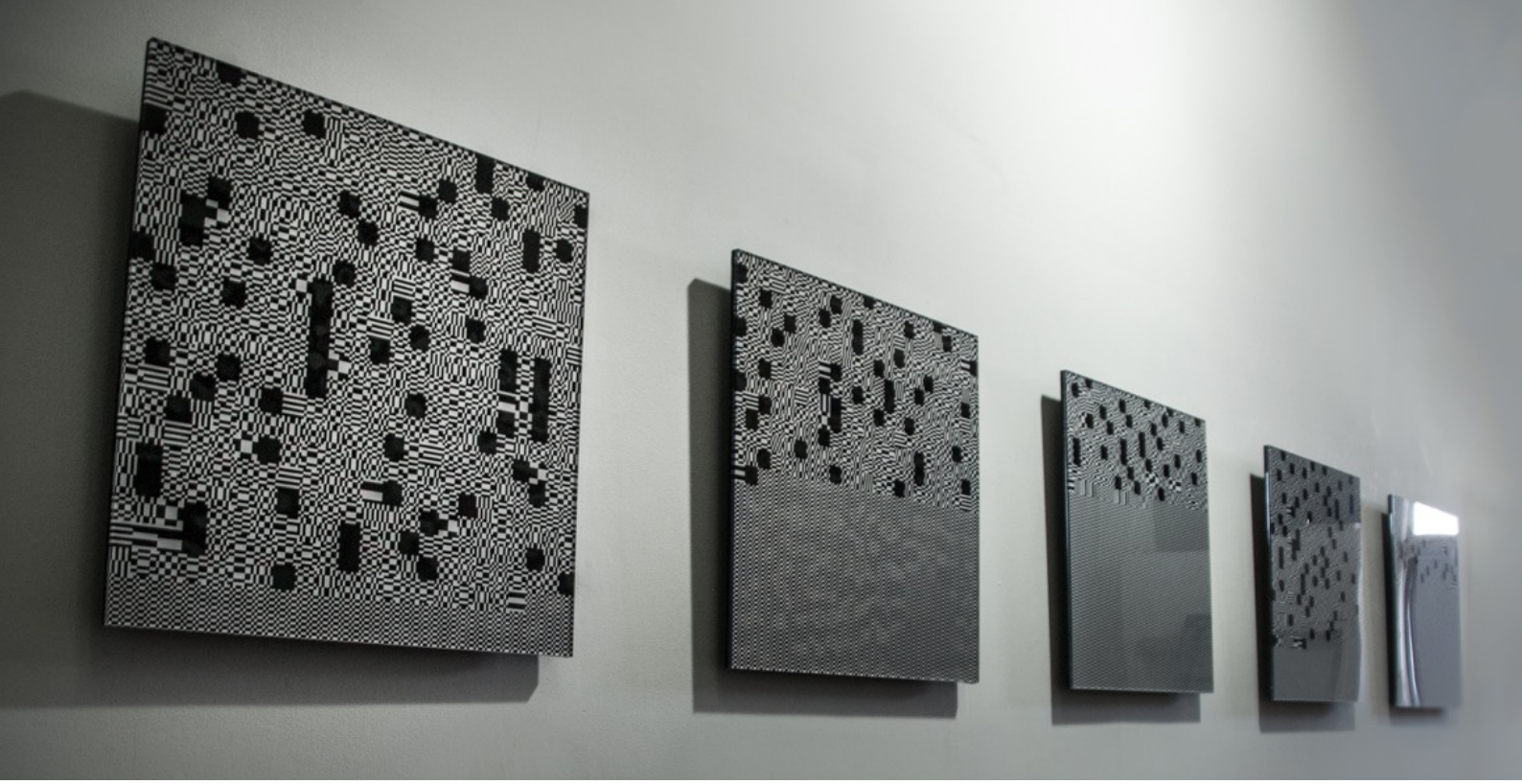
I.R.D.
RLE 010 0000 - 101 1111
⊠⊠⊠⊠⊠⊠ σ ≠ 1984



Institutions of Resolution Disputes (i.R.D.)

20” Acrylics; 5 institutions of the i.*R.D.*, encrypted in DCT (2015)

Institutions of Resolution Disputes [i.R.D.][89]

What an institution is or is not today, is hard to define. Some describe institutions as “stable, valued, recurring patterns of behavior.”[90] Others conjure up the image of bricks and mortar; physically present buildings that harbor formally organized organs that facilitate certain events or produce certain materials. An institution can be an organization founded for religious, educational, professional, or social purposes. Think for instance about a church, a library or an art collection.

Institutionalization is the process by which organizations and procedures acquire value and stability. But it is

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[89] Solo show at Transfer Gallery, NYC, March 28-April 15, 2015.

[90] Huntington, Samuel P.. *Political Order in Changing Societies.* Yale University Press: 2006: p. 12.

important to understand institutions not as a single entity but as an interconnected object in an networked field. Institutions are not isolated — their task is to mediate between employees, assets and audience or users. This is why there are at least two sides to any institution: the infrastructural and "content" part. The outwards facing part that produces knowledge, exhibitions or facilitates a sense of cohesiveness within the (sub)cultures it caters to and the framework or backend that keeps the institution running.

The back end of the institution determines the conditions of the front end — it develops conditions for creation and leverages the ways in which the institution interacts with other institutions, audiences and solicitors. This is why institutions need, at least to some degree, to be able to facilitate institutional recalibration: the capacity to rethink and remould the output and the logistical forms of the field. But some institutions are so encumbered with their status, that they cannot change, reform or recalibrate (quickly). They have to answer to rules that provoke a particular content, action or behavior rather than serve the cause they were actually erected for in the first place.

Between March 28th and April 15th 2015 I opened the i.R.D., in the form of a solo show at Transfer Gallery New York. The i.R.D. were created during a time in my life when I felt especially let down by institutions. I felt taken advantage of, and realized that institutions often work to keep their institute alive rather than to serve the purpose they have been erected for in the first place, ie. to serve and help the people that need them. During this time in limbo I developed the i.R.D, that consist of five institutions, through which I voice my critique on institutions: institutions should not consist of a group of people hiding themselves behind the title of "institution."

Though the i.R.D. mimic an institution, in reality they are not classic, institutional organs. Instead, the i.R.D. multiplex the term *institution* by revisiting its usage in the late 1970s. In this context, formulated by Joseph Goguen and Rod Burstall, institutions refer to a more compound framework that deals with growing complexities, connecting different logical systems (such as databases and programming languages) within the computer sciences.[91] The main result of these non-logical institutions is that different logical systems can be glued together at a substrata level, forming illogical frameworks through which computation can *also* take place: this type of institutions work for functionality, not for bureaucracy.

Inspired by the idea of hyperfunctional, yet illogical frameworks, the i.R.D. are dedicated to researching the interests of anti-utopic, obfuscated, lost and unseen, or simply too good to be implemented resolutions. They ask: what do the hegemonic conventions of sight obscure? Is there any space for 'fiat standards,' standards that are not backed by a reasonable intrinsic value, or standards that are maybe illogical? In doing so, the i.R.D. intend to shed a light on the processes behind cultural production: the systems of affordances, the politics of integration and imposition of templates.

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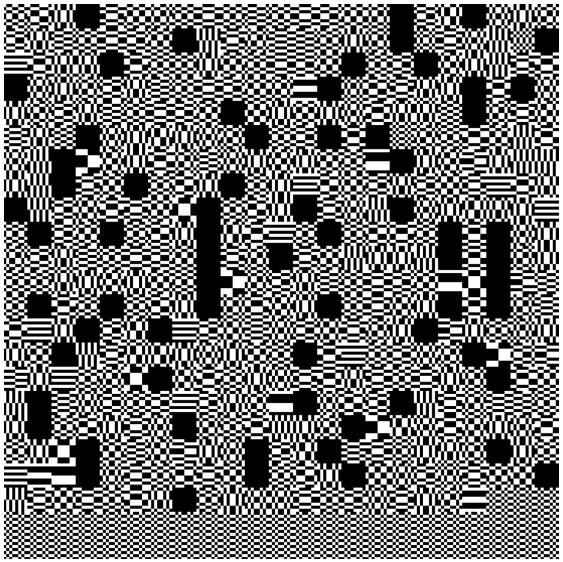
91 Goguen, Joseph A., and Rod M. Burstall. 'Institutions: Abstract model theory for specification and programming,' in: Journal of the ACM (JACM) 39.1 (1992): p. 95-146.

But while the i.R.D. call attention to resolutions, they do not just wish to aestheticize their formal qualities and put them on display: the i.R.D refuse to take the format of a *Wunderkammer.* This was already done by YoHa in their *Evil Media Distribution Centre.*[92] Institutions that intend to host disputes cannot get away with simply displaying objects of contention. Disputes involve discussions and debate. In other words: the objects need to be unmuted — or be given — a voice. A dilemma that informs some key questions: how can objects be displayed in an active way? How can the i.R.D. exhibit the (normally) invisible?

The institutions



The institutions of Resolution Disputes (i.R.D.) call attention to media resolutions. While a 'resolution' generally simply refers to a standard (measurement) embedded in the technological domain, the iRD reflect on the fact that a resolution is indeed a settlement (solution), but at the same time a space of compromise between different actors (objects, materialities and protocols) who dispute their stakes (framerate, number of pixels etc.) within the growing digital territories.

Common settings can ossify as generally accepted requirements or de facto standards, while other standards are notated as norms by standardizing organizations such as the International Organization for Standardization. We call this progress.
Moreover, resolutions are non-neutral standard settings that involve political, economical, technological and cultural values and ideologies; embedded in the genealogies and ecologies of our media. In an uncompromising fashion, quality (fidelity) speed (governed by efficiency) volume (generally encapsulated in tiny-ness for hardware and big when it comes to data) and profit (economic or ownership) have been responsible for plotting the vector of progress. This dogmatic configuration of belief x action has made upgrade culture one of the great legitimizers of scaled violence, putting 'insufficient' technological resolutions to rest. While a resolution can be understood as a manifold assemblage of common, but contestable standards, they should also be considered in terms of other options: those that are unknown and unseen, obsolete and unsupported.

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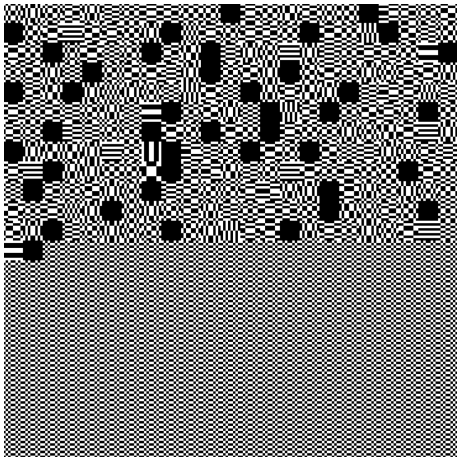
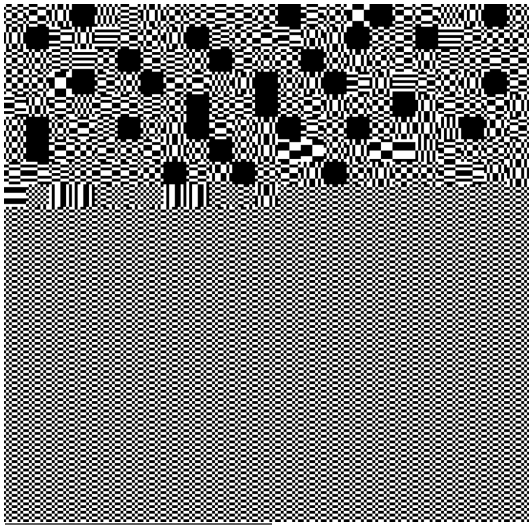
92 Yoha. Evil Media Distribution Centre (2013)
see: http://yoha.co.uk/evilmedia (20.02.20)



Resolutions inform both machine vision and human modes of perception. They ubiquitously shape the material of everyday life. They shape the material of everyday life ubiquitously. They do this not just as an "interface effect" but as hyperopic lens, obfuscating any other possible alternative resolution from the users media literacy.

As the media landscape becomes more and more compound: a heterogenous assemblage in which one technology never functions on its own; its complexities have moved beyond the fold of everyday settings. Technological standards have compiled into resolution clusters: media platforms that form resolutions like tablelands, flanked by steep cliffs and precipices looking out over obscure, incremental abysses that seem to harbor a mist of unsupported, obsolete norms. The platforms of resolution now organize perspective; they are the legitimizers of both inclusion and exclusion; of what cannot be seen or what should be done; while the fog, the other possibilities, become more and more obscure.

Yet, it is important to understand that resolution platforms are not inherently evil.[93] They can be impartial. It is important that we unpack these resolutions and note how they are conditioning our perception. A culture that adheres to only one or few platforms of resolutions supports nepotism amongst standards. These clusters actively impose notions of simplicity, masking the issues at stake and in turn savouring stupidity, which is bound to escalate into a glutinous techno-fascism.



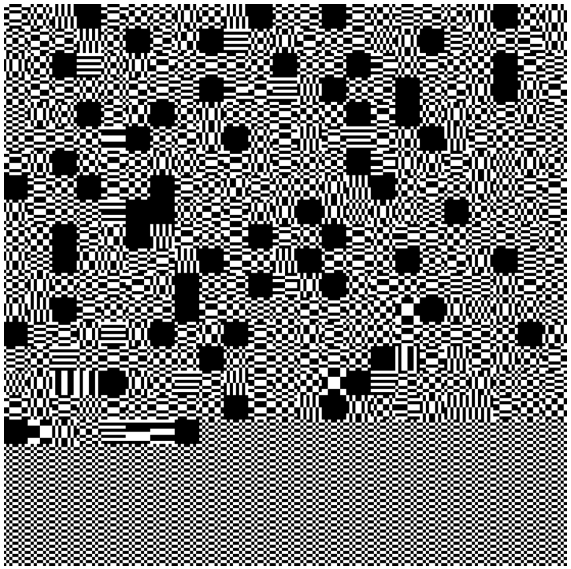
The question is, have we become unable to construct our own resolutions, or have we become oblivious to them? Either way we are in need for another re-"(Re-)Distribution of the Sensible".

Resolutions work not just as interface effects but as a hyperopic lens, which obfuscates any other possible alternative resolutions from the users' screens and media literacy. When we speak about video, we only ever refer to a four-cornered moving image. Why do we not consider video with more or fewer corners, timelines, or soundtracks. Fonts are monochrome: they do not come with their own textures, gradients, or chrominance and luminance mapping. Text editors still follow the layout of paper: there is hardly any modularity within

93 Andrew Goffey and Matthew Fuller, *Evil Media* (2012)

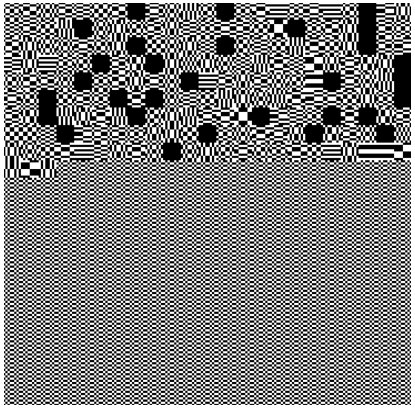
written-word technologies. Even ghosts, the figments of our imagination, have been conditioned to communicate exclusively through analogue forms of noise (the uncanny by default), while aliens communicate through blocks and lines (the more intelligent forms of noise).

We comfortably navigate resolution platforms; unknowingly suffering from technological hyperopia, we have lost track of the compromises that are at stake inside our resolutions and stare at screens, which show us mirage after mirage.



iRD intend to impose methods of "creative problem creation" to bring authorship back to the layer of setting a 'resolution'. The radical digital materialist believes in an "informed materiality"; while every string of data is ambiguously fluid and has the potential to be manipulated into anything, every piece of infor-mation functions within / adhesive*/ encoding, contextualization and embedding (etc).

A resolution is the lens through which constituted materialities become signifiers in their own right. resolutions resonate the tonality zeitgeist and constantly transform our technologies into informed material vernaculars. Technology is evolving faster than we as a culture can come to terms with. This is why determinations such as standards are dangerous; they can preclude the alternative.



through iRDs tactics beyond resolution, the otherwise grey mundane objects of everyday-life show their colors. iRD are not a wunderkabinet of dead media, but a foggy bootleg trails for vernacular resistance.

Progress has fathered many dead technologies. A *Wunderkammer*, or curiosity cabinet of media resolutions, would celebrate these dead objects by trapping them inside a glass bell, relieving them indefinitely of their action radius. While the i.R.D. adhere to the settlements of governing media resolutions, it also welcomes ventures along the bootleg trails of the tactical undead. These undead move beyond resolution, through the literacies of the governing techno-cultures, into liminal spaces. They follow the wild and uncanny desire paths that cut through sensitive forms and off-limit areas into speculative materialities. They threaten the status quo of secure media forms and provide the ambiguity that is so necessary for inspiration, action and curiosity.

We are in need of a re-(Re-)Distribution of the Sensible.[94]

The i.R.D. offers a liminal space for Resolution Studies. Resolution studies is not only about the effects of technological progress or about the the consequences of scaling. Resolution Studies analyzes how resolution embeds the tonalities of culture in more than just its technological facets. Resolution Studies researches the standards that could have been in place, but are not. As a form of vernacular resistance based on the concept of providing ambiguous resolutions, the i.R.D. employ the liminal resolution of the screen as a looking-glass. Here, hyperopia is fractured and gives space to myopia and visa versa. This is how i.R.D. expose the colors hidden inside the grey mundane objects of everyday life.[95]

The i.R.D. believe that methods of creative problem creation can bring authorship back to the layer of resolution setting.[96]

Resolution theory moves against what sometimes seems like an unsolvable compulsion to flatten reality. The i.R.D. might seem like a one way trail into the sea of fog and toward the abyss of techno-norms. It could also be a modular framework that opens and expands standards through inspection and reflection. As any good theory of media, resolution theory is a theory of literacy. Literacy of the machines, the people, the people creating the machines and the people being created by the machines. Through challenging the platforms of resolution, it can help the wanderer to scale actively between these states of hyperopia and myopia. It can uncover crystal cities of fog as well as shine a light on soon-to-be-distributed futures.
Here we can mine for the *timonds*.[97]

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94 Ranciere, Jacques. *The Politics of Aesthetics.* London: Continuum International Publishing, 2004.

95 Certeau, Michel de. *The Practice of Everyday Life.* Berkley: University of California Press, 1984.

96 jon.satrom, *Creative Problem Creation*, 2013.

97 Menkman, Rosa. *Glitch Timond*, 2014.
see: https://beyondresolution.info/Glitch-Timond

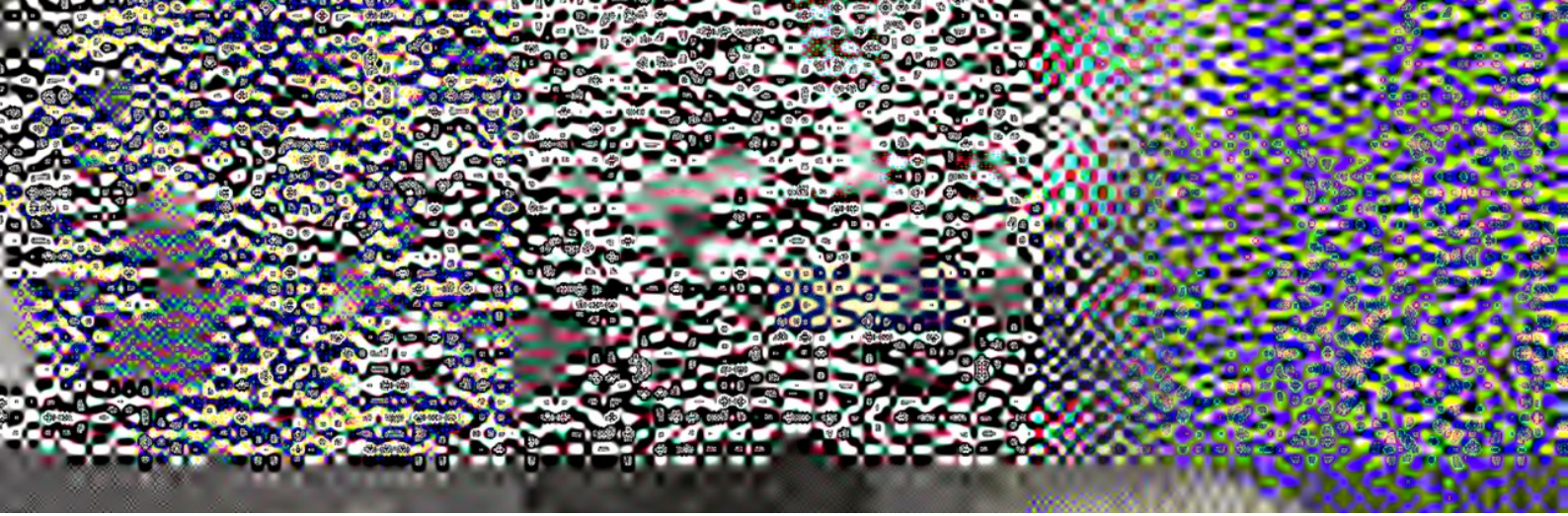
No objects, spaces, or bodies are sacred in themselves; any component can be interfaced with any other if the proper standard, the proper code, can be constructed for processing signals in a common language.

- Donna Haraway, A Cyborg Manifesto, 1985

Beyond Resolution. In which pattern recognition lost its resolution (2015)

15:30 min Live AV performance registration from Syndrom 3.X @ Static Gallery, Liverpool, January, 2015. Featuring remixed video images by Alexandra Gorczynski and my remixed sounds from the track Professional Grin by Knalpot. Sound mastering by Sandor Caron.
Features Ryan Maguires algorithm for MP3 compression, “Ghost in the MP3.”

Beyond Resolution is about the ghostly presence of absence, or the traces of a past captured in the present. The soundtrack Beyond Resolution features the Professional Grin and an inverted riff of Alvin Luciers’ “Sitting in a Room” experiment; one that only shows the “generation loss” instead of the generation left over, which is what we usually get to see or hear in art projects. In doing so it shows what sounds the MP3 compression normally cuts out as irrelevant — in a sense inverting the compression by putting “irrelevant” or deleted data on display.



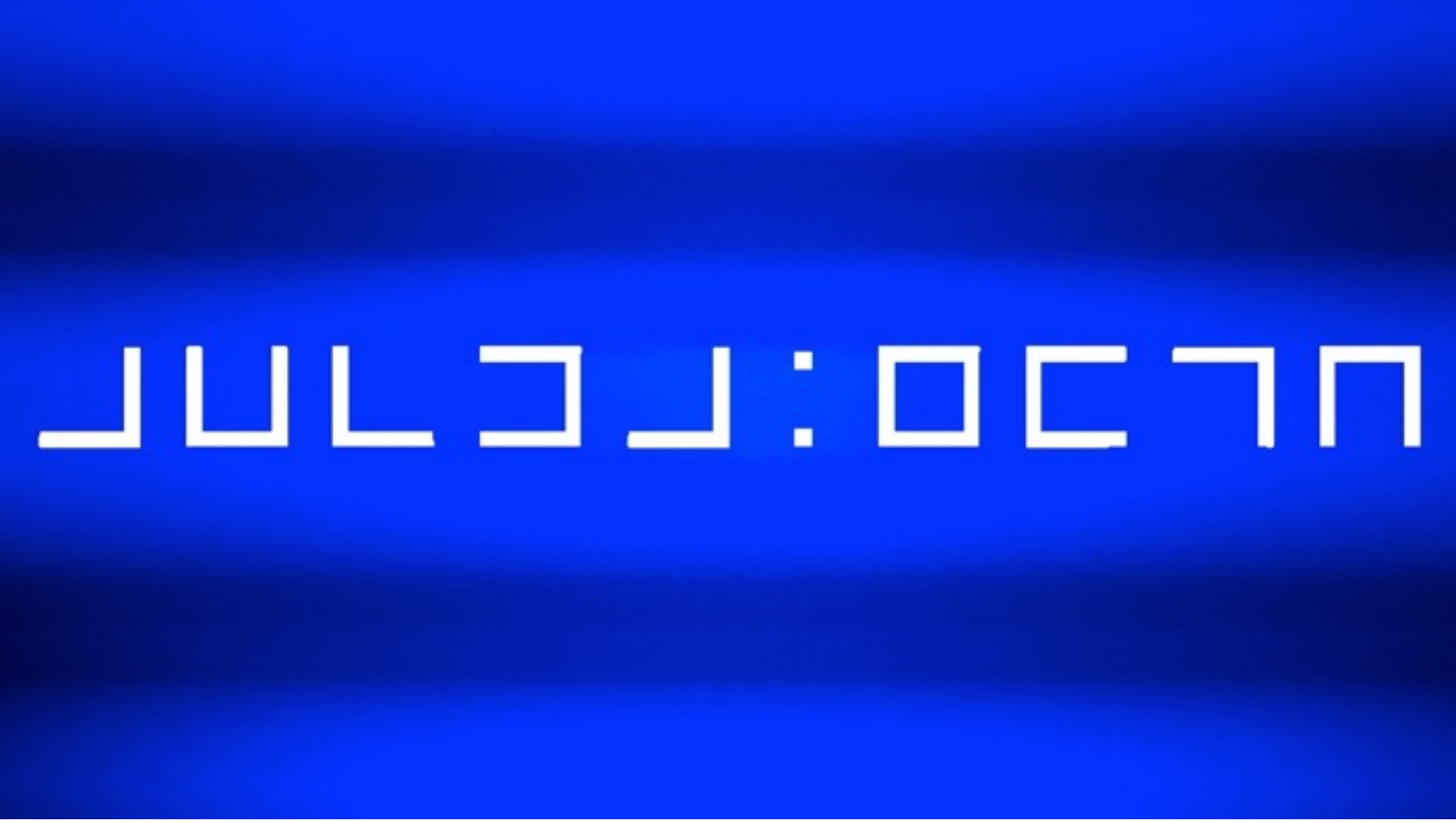
yopia (2015)

12x4 meter wall vinyl installation with extruding vectors.

Resolutions are the determination of what is run, read, and seen, and what is not. In a way, resolutions form a lens of (p)reprogrammed truths. Every time a new way of seeing; a new resolution is developed; a new pre-history of the history of the image is made; this new resolution forms a new lens of truth — a force that is revealed only retrospectively. But these actions and qualities take place beyond the fold of our perception, which is why we have gradually become blind to the politics of these congealed and hardened compromises. We are collectively suffering from technological hyperopia.

Myopia is a giant vinyl wall installation (12 x 4 meters), plus extruding vectors that present a zoomed-in perspective of JPEG2000 wavelet compression artifacts. These artifacts were the aesthetic result of a glitch, made when I added a line of another language into the data of a high res JPEG2000 image — a compression standard used and developed for medical imaging, supporting zoom without block distortion. This action revealed both the surface and structure of the image.

The title *Myopia* hints at a proposal for healing our collective suffering from technological hyperopia: a broad condition of farsightedness. With *Myopia* I build a place that disintegrates the architecture of zooming and endows the public with qualities of short-sightedness. The scope exists in the depth of the image or even behind the image. This was echoed in the conclusion of the installation the day before the i.R.D. show closed, when visitors were invited to bring an exacto blade and to cut their own resolution of *Myopia* to mount on any institution of choice: a book, computer or other rigid surface.



acit:Blue (2015)

2 min. single channel video
A discussion between a Masonic pigpen and DCT

hardware used: NovaDrone by Casper Electronics w/ custom patching.
Cipher:
X
· X ·

Tacit:Blue is a reference to the old Northrop Tacit Blue stealth surveillance aircraft, which was developed against passive radar detection. The Tacit Blue aircraft is now decommissioned, as is the masonic pigpen encryption, in which the video carries an encrypted message. Every flash shows the next line of my "secret message." As Daniel Rourke comments, "These technologies were designed to exist beneath, or parallel to, optic thresholds, but now these thresholds are not optic as much as they are about digital standards and

resolution densities."[98]

In *Tacit:Blue* small interruptions appear in an otherwise smooth, blue, video document of a conversation between two cryptography technologies: a Masonic Pigpen or Freemasons cipher (a basic, archaic, and geometric simple substitution cipher) and the Discrete Cosine Transform encryption *DCT* (Menkman, 2015). The sound and light that make up the blue surface are generated by transcoding the same electric signals using different components; what you see is what you hear.

The technology responsible for the audiovisual piece is the *NovaDrone* (Pete Edwards/Casper Electronics, 2012), a small AV synthesizer designed by Casper Electronics. In essence, the *NovaDrone* is a noise machine with a flickering military RGB LED on top. The synthesizer is easy to play with; it offers three channels of sound and light (RGB) and the board has twelve potentiometers and ten switches to control the six oscillators routed through a 1/4-inch sound output, with which you can create densely textured drones, or in the case of *Tacit:Blue*, a rather monotonous, single AV color/frequency distortion.

The video images have been created using the more exciting functions of the *NovaDrone*. Placing the active camera of an iPhone against the LED on top of the *NovaDrone*, which turns the screen of the phone into a wildly moving suprematist collage of color bars, revealing the *NovaDrone's* second practical usage as a light synthesizer.

In this process the *NovaDrone* exploits the iPhone's CMOS (Complimentary Metal-Oxide-Semiconductor) image sensor, a technology that is part of most commercial cameras, and is responsible for the transcoding of captured light into image data. When the camera function on the phone is activated, the CMOS moves down the sensor capturing pixel values one row at a time. However, because the flicker frequency of the military RGB LED is changed by the user and higher than the writing speed of the phone's CMOS, the iPhone camera is unable to synch up with the LED. What appears on the screen of the iPhone is an interpretation of its input, riddled with aliasing known as rolling shutter artifact; a resolution dispute between the CMOS and the RGB LED. Technology and its inherent resolutions are never neutral; every time a new way of seeing is created, a new pre-history is written.

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98 Rourke, Daniel. 'Resolution Disputes: A Conversation Between Rosa Menkman and Daniel Rourke.' in: *Furtherfield*, 2015. see: https://www.furtherfield.org/resolution-disputes-a-conversation-between-rosa-menkman-and-daniel-rourke/

We shape our tools and, thereafter our tools shape us.

— John Culkin[99]

Conclusion: a need for Shadow Knowledge

Our (digital) cultures are in a state of hypertrophy: faster, better, shinier, deadlier; more awful and overexposed. It is hard to stay on top of the dialogue and keep an eye out for the newest problem, or even to find the contemporary discourse. What is really happening *now*? How does the flow and functioning of contemporary culture — the culture of now — construct itself?

Just like maps, images have the power to not just describe the world; they are partially responsible for creating it. They conjure a lens through which we look and perceive. And guide us in our understanding, our thoughts and actions. But in a far more obscure and violent way, the technologies (its protocols, interfaces and infrastructures) through which we access and create our images (e.g. image processing technologies or image data capture devices) also engender distortions of our perception. As Anil Dash states: "technology isn't an industry, it's a method of transforming the culture and economics of existing systems and institutions."[100] This is why technology should always be the subject of scrutiny and debate.

However, in comparison to other fields such as law or medicine, ethics has never been (a big) part of technological education. Given that the fields of software engineering are devoid of such tradition, it has long been a free for all. And this has shown time and time again in the choices developers (hardware, software and UIX designers) have made. While every choice they make is engrained with consequences, we are still far away from fully understanding or pro-actively challenging for instance the profound privacy, security and racial biases that are embedded within the products they deliver us.[101]

Technology has been biased for decades, if not centuries and quite possibly there is no such thing as unbiased technology. When I write *technology* I mean not just our digital imaging technologies: these histories

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99 Culkin, J.. 'A schoolman's guide to Marshall McLuhan,' in: *Saturday Review*, 1967: p. 70.

100 Dash, Anil. 'There is no 'technology industry,' in: *Medium*, Aug 19, 2016.
see: https://medium.com/humane-tech/there-is-no-technology-industry-44774dfb3ed7

101 Dash, Anil. 'There is no 'technology industry,' in: *Medium*, Aug 19, 2016.
see: https://medium.com/humane-tech/there-is-no-technology-industry-44774dfb3ed7

go as deep as the electricity grid, the sewer or our system for public transportation. Researchers such as Ingrid Burrington[102] have shown how different forms of infrastructure can be recognized, mapped and uncovered, even in the space of our day to day neighbourhoods. There is a huge value to this kind of infrastructural research and its consequential tourism: it is a way to train ourselves at recognizing and unpacking the increments of obfuscation and the different scales at which these infrastructures function and exist. It can help us with expanding and questioning our resolutions, in the fight to regain our agency.

At the very basis of such fight lies the understanding that any software, hardware or interface has (habitual) values engrained inside of it. As Safiya Umoja Noble states: "Infrastructure is created by people and therefore embeds and reflects the values of the people who create it."[103] To be able to ignore or unsee these (infrastructural) resolutions that govern our digital technologies, and thus our daily realities, or to presume these infrastructures are "hidden" or "magic," is an act reserved only to the digitally illiterate. To formulate questions around how our technologies work, is a prerequisite for actively taking part and harnessing agency in our contemporary society.

Still, compromises and biases are often waved away as 'accidents;' they are the result of an uninformed engineer or an unfortunate byproduct of a financial calculation. A main point of *Beyond Resolution* is that we can no longer ignore these unfortunate 'accidents'. To develop technology in an uninformed matter and consequently perpetuate biased engagement is not ok: we are at a point when we can choose what biases to implement; good, bad or neutral. We can choose our compromises. But of course before we can challenge these imposed biases and compromises - we need the tools not just to recognise and understand them, but to speculate on other possibilities.

And this is what *Beyond Resolution* has tried to insist on: an extended formulation of resolution. A resolution is not just a trade-off between settings that manage speed and functionality (bandwidth, control, power, efficiency, fidelity), while at the same time considering claims in the realms of value vs. storage, processing or transmission. A resolution also always involves an inherent compromise of other ways of rendering, and it is in these *other ways* that we need to train to see, run and formulate our alternatives.

With the example of the genealogy of the color test cards I offered one way to make such latent and biased power structures more apparent: we need to insist that these standard images, trapped in the histories of our technologies, become part of the public domain. In order to illuminate the white shadows that govern the outcomes of our image processing technologies, we must document the genealogies of standardization. These genealogies belong in high school textbooks: the latent violence coded within such norms should be studied as

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102 Burrington, Ingrid. *Networks of New York: An illustrated field guide to urban internet infrastructure*. Melville House, 2016.

103 Noble, Safiya Umoja. *Algorithms of oppression: How search engines reinforce racism*. NYU Press, 2018.

part of standard curricula to inform a future generation of engineers of compromises made in the past.

It is often said that all we have is the past to train with. I believe there is truth to that. But some importance also lies in our contemporary state. Art schools, academies, universities and other institutions that study and teach new media or engineering play an important role here. They need to keep training their students but also *the institution itself* to not only critically engage with newly developed materialities, protocols and languages, but also — and I believe that this is where the 'new' in new media comes in — to develop a certain fluid literacy around these constantly developing and mutating materialities. Because they impose constraints and qualities on their content, or often even form the content themselves.

But how can we study new media, its materialities, resolutions and compromises, when they are not fixed but rather constructed as a constant "interplay between a text's physical characteristics and its signifying strategies"?[104] To engage with digital culture means to be able to formulate a critical point of view, which involves analysis and active change through critical thought processes, such as speculation. Uncovering and studying these spaces of speculation is of vital importance and it is here where we find a growing need for players such as artists, theorists, designers and many others, who continue to engage critically with contemporary cultures. We need a fundamental acceptance of Shadow Knowledge: in the shadows, things lack definition. It is where we can find objects of unsupported dimension and scale, ambiguous and fluid. The shadows are blurry and liminal, but ultimately potent spaces that can exist between what is enlightened and opaque (or black boxed). Shadows offer shady outlines, that can function either as a vector of progress or a paint by numbers. In the shadows we can rest, heal and recalibrate. Now is not the time to hope or fear. It is the time to look for new weapons. The future lies in the shadows of our present.

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104 Hayles, Katherine. 'Print is flat, code is deep: The importance of media-specific analysis,' in: *Poetics Today* (*25*, no. 1 2004): p. 67–90.